Draft
Fill Site 6A
Restoration Plan
Presidio San Francisco
San Francisco, California

Prepared for:

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MACTEC Project No.: 55213 00217

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1.0 INTRODUCTION

On behalf of The Presidio Trust (Trust) and in conjunction with Clearwater Hydrology, Inc. (Clearwater) and Watershed Science, Inc. (Watershed), MACTEC Engineering and Consulting Inc. (MACTEC) has prepared this Restoration Plan (Plan) that describes anticipated activities for construction and stabilization of a new open channel at Fill Site 6A, Presidio of San Francisco (Site). Clearwater provided the sections pertaining to the hydraulic and geomorphic design described in this Plan. MACTEC provided sections pertaining to the remediation work, and the Trust provided landscape restoration and revegetation sections.

The Trust plans to remove an area of contaminated fill soil and building debris located in the northeast corner of the Presidio of San Francisco (Presidio; Fill Site 6A; Figures 1 and 2) consistent with our regulatory requirements for hazardous substance site remediation at Fill Site 6A. During the course of the Site cleanup activities, the underlying utilities will be removed or relocated. Among these is a 72-inch diameter storm drain containing approximately 430 feet of the Tennessee Hollow creek system. Rather than replace this pipeline following cleanup work, the Trust proposes to direct flow into a new surface channel. The channel will be carefully designed to ensure stability and revegetated to enhance filtration and natural and aesthetic values of this highly visible location of the Presidio. The project will be performed in two phases. Phase I entails the remediation activities to remove construction debris and fill soil from the Site. Phase II will stabilize and revegetate the Site including the construction of the new surface channel. Phase I activities include:

- Relocation of active above- and underground utilities;
- Removal of obsolete or abandoned utilities;
- Excavation of contaminated fill soil and construction debris;
- Exposing clean native soil;

- Cutting and removing a 72-inch diameter storm drain that now traverses the Site; and
- Confirmation soil sampling of the clean native soil.

Phase II will begin after the remediation portion of the project is complete, and consists of:

- Construction a new channel for the re-exposed drainage course, and
- Revegetation of the Site using a combination of native and ornamental plants.

The channel construction will be performed by the restoration contractor; the vegetation restoration will be performed by the Trust vegetation staff and vegetation contractors.

An important aspect of this project is the transition between the work conducted by the remediation contractor (Phase I) and subsequent work conducted by the restoration contractor (Phase II) with respect to diversion of water and sediment during remedial and restoration activities. As outlined above, Phase I will be completed after confirmation sampling shows that remediation goals have been achieved. The existing 72-inch storm drain pipe will have been removed from the Site, thus exposing the underground water course formerly contained in the pipe. As required in the remedial contractor’s contract, before work on Phase I begins, the remedial contractor will submit a “Storm Drain Relocation Plan” to the Trust to assure that there will be no release of contaminated water and sediment downstream. This plan will describe how the expected flow contained in the existing storm drain pipe will be captured and conveyed to the downstream end of the Site during the removal of the storm drain pipe. This plan will also be reviewed by the restoration contractor to facilitate the transition between the remedial and restoration contractors in maintaining the watercourse diversion as work shifts from Phase I to Phase II. The temporary flow diversion will be removed by the restoration contractor after the new stream channel and its appurtenant structures have been completed.

The transition between the restoration contractor and vegetation implementation is important. The Trust Plant Ecologist will coordinate daily with the restoration contractor to assure that the soil surface treatment is adequate for native plant establishment.

The Phase I work is described in a Work Plan prepared by the Trust *(MACTEC, 2004)* that was submitted to regulatory agencies in June 2004. This Restoration Plan describes the work to complete Phase II of the project.

1.1 Background and Site Description

FS 6A is located at the northeast corner of the Main Post area, northwest of the former Letterman Complex (Figure 1), and has been part of the developed portion of the Presidio since the early 20th century. The area affected by the Phase II work is generally bounded by Lincoln Boulevard to the south, Building 1030 to the north, Building 222 parking lot to the west and Girard Road to the east. Several above- and under-ground utilities, both in-service and abandoned, transect the Site. The Site is also surrounded by several historic structures including Building 222, Building 223, Building 225, Building 226, and a stone retaining wall that parallels and borders Lincoln Boulevard. Site features are illustrated on Figure 3.

The Site is approximately 2.5 acres with dimensions of approximately 450 feet (in the north-south direction) and 280 feet (in the west-east direction). Ground surface elevations range from approximately 40 feet Presidio Lower Low Water (PLLW) at the south end of the site (adjacent to Lincoln Boulevard) to about 20 feet PLLW at the north end of the site (west of Building 1030). The Site is currently an open grassy mound with a cluster of redwood trees located in the eastern portion of the Site. The existing storm drain is currently contained within a 72-inch diameter reinforced concrete pipe (RCP) that crosses the site from south to north. The RCP was installed by the Army prior to the 1940s.

Historic buildings are located along Halleck Street, and non-historic residential buildings are located along the Site's northern border. The Site formerly contained a railroad spur and two warehouses as well as nurse's quarters along Girard Road. The warehouses were demolished by the Army sometime after the 1960s and the

nurse's quarters were demolished in the 1980s. It appears that the area was filled with soil and building debris after the buildings were demolished.

Investigations performed by the Army in the 1990s and more recently by the Trust, show that the Site is underlain by unconsolidated sediments of the Colma formation. Colma sediments are overlain by fill of variable thickness that ranges up to about 15 feet thick.

Chemicals previously detected in fill soil above cleanup levels include metals (mercury, cadmium, and zinc) and polychlorinated biphenyls (PCB 1260). Because cadmium and zinc concentrations appear to be within ambient (background) concentrations, only PCB 1260 and mercury were identified as contaminants of concern (COCs) for the remedial action. Soil cleanup levels selected for FS 6A were Ecological Special Status Species Zone (ESSSZ) levels, which are generally the most stringent cleanup levels used at the Presidio. Previous sampling results show that PCB 1260 was detected above the ESSSZ cleanup level at three locations and mercury was detected above the cleanup level at one location.

Monitoring of groundwater by the Trust has shown that selenium and zinc concentrations exceeded cleanup levels for groundwater in previous sampling events *(Treadwell & Rollo, 2004)*. However the exeedance of cleanup level for selenium may be an artifact of sampling, and the exceedance of the cleanup level for zinc may be inadequate filtering of samples prior to analysis. Nevertheless, selenium and zinc are groundwater COCs.

The Trust has prepared a Remedial Action Plan (RAP) that has been approved by the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) *(Treadwell & Rollo, 2004)*. The selected remedial action in the RAP consists of removing the contaminated fill to expose uncontaminated native soil below. In order to complete fill removal, the Trust has elected to cut and remove the 72-inch diameter storm drain that traverses the Site. After the fill soil and storm drain have been removed, the Trust will grade the Site to create a new open channel and revegetate the area with native and ornamental plants.

1.2 Regulatory Framework

Cleanup of Fill Site 6A is being performed under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as administered in California by DTSC. The CERCLA process, which is summarized in the RAP, includes California Environmental Quality Act (CEQA) review of the project as well as public notification and comment. The project has also been the subject of a consultation with the California State Historic Preservation Office (SHPO), which concluded that the proposed remediation and native plant and landscape restoration (including protective measures) would not degrade features that contribute to the Presidio's National Historic Landmark designation.

CERCLA contains a permit exclusion that eliminates the need to apply for federal, state or local permits that might otherwise be necessary to perform the remediation work. Under this exclusion, the Trust must comply with the substantive requirements of other programs, but is not required to obtain other state or local permits before starting work. The Trust has discussed this exclusion with California Regional Water Quality Control Board, San Francisco Region (RWQCB) staff, who has agreed that preparation of this restoration plan would satisfy RWQCB concerns regarding substantive compliance with the requirements of Section 401 of the Clean Water Act. The Trust has discussed this project with staff of the U.S. Army Corps of Engineers, San Francisco District (USACE). The USACE staff concluded that notwithstanding the CERCLA permit exclusion, no Section 404 permit would be required for this project.

1.3 Remedial Action

As summarized in the RAP for Fill Site 6A, the Trust analyzed five possible remedial actions, ranging from no further action to complete removal and off-site disposal of all fill soil. The selected and DTSC-approved remedial action consists of:

1) Excavating and removing contaminated fill soil;

2) Segregating inert construction debris for off-site recycling;

3) Confirmation sampling of remaining native soils to establish that cleanup goals have been met;

4) Disposal of the contaminated soil and debris at an off-site licensed disposal facility; and

5) Three years of post-cleanup groundwater monitoring.

Cleanup levels for soil in the RAP are based on the most stringent of the values for protection of human health (residential land use), protection of ecological receptors (ecological special status species), protection of ecological receptors (freshwater and salt water aquatic organisms), and maintaining drinking water standards in groundwater (soil less than or greater than 5 feet above groundwater, as applicable). In the case of metals, if the background metals concentration for Colma lithology is greater than the most stringent cleanup level, then the background concentration applies as the cleanup level. Cleanup levels for groundwater are based on the most stringent of the values for maintaining water quality criteria for drinking water and surface water *(Treadwell & Rollo, 2004)*.

1.4 Channel Construction

After the fill soil and the 72-inch drain have been removed from the Site and confirmation sampling indicates that COC concentrations in native soils meet cleanup levels, construction of the new channel will begin. The temporary relocation of the watercourse, in accordance with the remediation contractor provided "Storm Drain Relocation Plan", will still be in place after the remediation contractor demobilizes from the Site. The restoration contractor will have reviewed and approved this plan prior to the start of work and will maintain the watercourse diversion after the remediation contractor has left the Site during final grading and channel construction. Restoration construction work will be performed by Watershed in accordance with a design prepared jointly by Watershed and Clearwater. These firms specialize in creek and watershed restoration.

Watershed will construct the new channel, including in-stream features (e.g. rapid-pools), refined grading of off-stream wetlands and transitional upland slopes, and biotechnical stabilization measures. Clearwater, the project hydrology and channel design contractor, will provide construction quality assurance (CQA) services to assure that project implementation is in accordance with the design. Due to some remaining uncertainty

regarding the exact alignment of the existing 72-inch storm drain and its invert elevation along the reach, it is anticipated that some minor design adjustments will be required after the fill material and the underlying pipe segment are removed. The Watershed/Clearwater team has extensive experience with making field adjustments while sustaining the integrity of the restoration plan.

New headwalls will be constructed where the 72-inch storm drain pipe has been cut. The upstream headwall will be constructed as a storm drain outfall structure featuring a stilling basin containing embedded weathered basalt boulders. The stilling basin will transition to the channel constructed in the native Colma soils. The downstream headwall will be constructed as a storm drain inlet structure with companion headwalls.

Erosion control measures for the site will be identified in the Storm Water Pollution Prevention Plan (SWPPP; Section 3.1.2) and subsequently in a Long Term Erosion Control and Monitoring Program (Sections 4.2 and 4.3).

1.5 Native Plant Revegetation

Plant and landscape restoration will be performed in accordance with the Vegetation Management Plan (VMP), the Presidio Trust Management Plan (PTMP), and a site-specific Vegetation Revegetation Action Plan (VRAP) that applies to the native plant zone restoration. As shown in Figure 8, the site revegetation includes use of four separate native plant communities and a landscape plant community located in specific planting zones. The revegetation plan is designed to create a transition from native plant zones within and adjacent to the new channel to the landscape area beginning at the redwood trees going east to Girard.

The plant species selected for revegetation of Fill Site 6A represent species that are locally appropriate for use along the stream corridor. Table 1 lists the plant species selected for each planting zone. Remnant riparian and wetland plant communities of the northern San Francisco peninsula were used as general reference sites, including the watersheds of San Bruno and Montara Mountains as well as Presidio sites such as Lobos Creek, Dragonfly Creek, and various local seeps and swales.

Appropriate species were selected based on a review of the following sources: 1) the current flora of the Presidio *(Fontaine M., 2003)*; 2) the current Presidio flora list, selecting species known to grow locally in the target plant community; and 3) the plant community list, selecting species for which there are currently sufficient propagules to meet propagation and revegetation goals. From the initially identified list, a final list was developed which favored the most hardy and abundant species.

2.0 HYDROLOGY, HYDRAULIC AND GEOMORPHIC DESIGN

This section describes the existing hydrology and hydraulic conditions at the Site and its watershed. This section also summarizes the results of hydraulic calculations contained in Appendix A. These calculations represent the basis for the new channel design as well as the design for the new storm drain outfall and inlet structures.

2.1 Existing Hydrology

Fill Site 6A is located within the Tennessee Hollow Watershed which drains roughly 270 acres of partially urbanized hillsides and terrace lands draining north to the Crissy Field Marsh and the San Francisco Bay. Storm water from the Main Parade Ground (outside of the watershed) is also directed into the storm drain system just upstream of Fill Site 6A. Flows vary seasonally and are supported by discharges from groundwater springs, surface runoff during storm events, and irrigation.

Rainfall in the central coast region of California occurs during the wet season which typically extends from October to April. Additional moisture is available to the watershed via coastal fog which occurs frequently over the morning and evening hours during the otherwise dry summer season (May through September). The mean annual rainfall in the vicinity of the project site is 20 inches *(Rantz, 1971a)*.

Surface runoff in the watershed is enhanced by impervious surfaces (e.g. roads, parking lots and roofs) and the prevalent storm drain system. These impervious surfaces restrict the recharge of the shallow aquifer due to the diversion of direct rainfall and surface runoff to the storm drain system. Peak discharges during rainstorms are elevated due to runoff from impervious surfaces and the relatively short time of concentration for runoff, which is a function of the steep watershed slopes and the dense storm drain network.

Aside from local nuisance flooding due to obstructed storm drain inlets, flooding has not historically been a problem in the watershed. Since the future flow line of the new channel constructed at Fill Site 6A will be significantly lower than the surrounding area, neither flood water surface profile modeling nor complex

watershed modeling (i.e. modeling of all physical hydrologic processes) was considered crucial for the design of the new channel. Further discussion of on-site flooding, including the influence of tidal backwater effects is presented in Section 2.2, Hydraulic and Geomorphic Design.

2.1.1 Local Hydrologic and Hydraulic Conditions

The existing topography of Fill Site 6A is undulating, reflecting its use as a fill disposal site for the Army during its tenure at the Presidio. Direct rainfall and local surface runoff that is generated over the fill area and the adjoining hillsides either ponds locally in depressions on the surface of the fill or flows overland toward the northern end of the Site just west of Building 1030 where runoff enters the storm drain system via a grated drop inlet.

The main storm drain feature at the Site is a 72-inch storm drain pipe that conveys storm water runoff from upstream areas of the watershed to the storm drain outfall at the east end of the Crissy Field Marsh. This pipe is located in the western portion of the Site and traverses the Site in a south-north alignment (Figure 3). Most of the runoff retained in depressions on the surface of the fill area infiltrates into the primarily sandy material and recharges the shallow groundwater system.

The 72-inch storm drain pipe segment traversing the Site originates at the upstream end of the Site at a junction with an upstream 60-inch storm drain pipe segment. The junction is located 20 feet north of the historic rock wall, which is adjacent to and just north of Lincoln Avenue. The current 72-inch storm drain pipe alignment extends northwest from the junction, then northeast, adjacent to and roughly paralleling Halleck Street. At the downstream end of the project reach, the 72-inch storm drain pipe continues northward under a concrete walkway/stairs, ultimately discharging to the Crissy Field Marsh. The only other storm drain discharge feeding the 72-inch storm drain pipe within the boundary of the project reach is a 12-inch terra cotta storm drain lateral. This lateral collects storm water runoff along Halleck Street. This storm drain will be abandoned as part of the remediation work and a new storm drain along Halleck Street will convey storm water from this location further downstream, where it will again connect to the 72-inch storm drain.

In June 2004, the Trust conducted an exploratory excavation to assess the 72-inch storm drain position and elevation because no accurate construction records were available. The excavation was performed on a section of the pipe in the northern portion of the Site. At this location, the groundwater table was measured to be at an elevation of approximately 3.0 feet National Geodetic Vertical Datum 1929 (NGVD 29 equals the 1929 mean sea level). This elevation is close to the elevation of the San Francisco Bay shoreline where regional groundwater surfaces. The mean high water datum for San Francisco Bay at the Presidio gauging station is 2.4 feet NGVD 29.

The excavation confirmed the alignment of the storm drain segment as well as inferred invert elevations at the upstream and downstream site boundaries. Based on this information, the storm drain pipe invert elevations, which represent the fixed start and end elevations for the channel restoration, were estimated to be 14.0 feet and 4.0 feet, respectively.

2.1.2 Peak Flow Rates

Clearwater computed peak flow rates for the entrance to the project channel reach adjacent to the intersection of Lincoln Avenue and Halleck Street using the United States Geological Survey (USGS) version of the Rational Method *(Rantz 1971b)*. For the purpose of channel design, peak flow rates were computed for the 2-year, 10-year, and 100-year storm events. The 2-year storm event is approximately equal to the bankfull discharge, which typically corresponds to a flood recurrence interval of 1.5 to 2.0 years. This discharge, also known as the channel-forming discharge, is applied in the determination of geomorphic parameter values that guide channel design. For the planned restoration, the 10-year and 100-year discharges were used to determine the required headwater depths at the downstream storm drain inlet and the maximum shear stresses that will affect the stability of in stream weir elements.

The USGS version of the Rational Method was developed for the San Francisco Bay Region and can be expressed as the following equation:

$$Q = C * I * A$$

where:

Q= peak discharge, cubic feet per second (cfs)

C= runoff coefficient, dimensionless

I= rainfall intensity, inches/hour

A= drainage area, acres

For the watershed, the estimated composite runoff coefficient of 0.33 was determined based on the weighted component runoff coefficients cited for the dominant land uses (i.e. natural watershed, public buildings and mixed public buildings and residential) in Table 1 of *Rantz, 1971b*. This value was increased to 0.63 for computation of the 100-year peak discharge (as per Figure 5 in *Rantz, 1971b*). The computed time of concentration for runoff (t_c), was computed as the sum of travel times for headwaters (overland), natural channel and storm drain reaches upstream. Storm drain maps supplied by the Trust were referenced to determine the extent of storm drain installation (sewering) and the approximate pipe slopes. Based on the computed t_c of 30.6 minutes, the design rainfall intensities for the 2-year, 10-year, and 100-year rainstorms were determined to be 0.74 inches per hour (in/hr), 1.14 in/hr and 1.55 in/hr, respectively.

The peak flow rates for the selected recurrence interval rainstorms were calculated using the above mentioned parameters and are as follows:

Storm Recurrence Interval (years)	Watershed Area (acres) [1]	Peak Discharge (cubic feet per second)
2	246.8	60.3
10	246.8	92.8
100	246.8	241

1) Local watershed outlet at the existing 60-inch/72-inch diameter RCP junction under Lincoln Avenue.

All peak flow computations are presented in Appendix A.

Prior peak flow estimates for the restoration reach at Fill Site 6A prepared by Kamman Hydrology & Engineering, Inc. *(Kammon & Kammon, 2003)* (Q100= 215 cfs, Q10= 102 cfs, Q2= 46.5 cfs) are generally

comparable to the Clearwater-derived estimates cited above. The divergence in the Q2 estimates probably derives from slight differences in the assumed runoff coefficient “C” values associated with proportioned land uses and/or with the natural watershed component. The impact of “C” value determinations on peak flow rates is masked for higher recurrence interval storms due to the higher runoff efficiency of the more saturated watershed soils during these events.

In less developed watersheds, peak flow rates for individual storm events are often augmented by a base flow that exists at the onset of the event. However, in the current situation, this component was ignored due to the significant extent of sewering within the watershed (including the effect of groundwater draining via storm drain infiltration) and the restricted opportunities for groundwater recharge.

2.2 Hydraulic and Geomorphic Design

2.2.1 Fluvial Geomorphic Setting

Geomorphologically, Fill Site 6A occupies a transitional zone toward the lower end of Tennessee Hollow watershed. Although it is located just upslope of the shoreline/tidal zone, it may be subject to tidally influenced backwater during some higher magnitude discharges (e.g. greater than 10-year event at high tide) under open channel conditions. Information on the original valley topography is limited. For the purposes of this evaluation, it has been assumed that the existing valley slopes are similar to those of the original, pre-disturbance (i.e. pre-1776) watershed condition. The general valley profile can be assumed to roughly parallel to the original profile. The existing valley slope along the project reach was estimated from site topographic mapping at approximately 3 percent.

Clearwater staff assessed the character of sediment along the lower reaches of the watershed by conducting a field inspection of bed sediments along the channel, upstream of the Presidio Boulevard crossing. In this reach, the low flow portion of the surface channel is concrete-lined, but the adjoining floodplains are functional and vegetated. The reach receives water and sediment flows from three watercourses in the Tennessee Hollow watershed. Bed sediments sampled downstream of this confluence consisted principally of coarse sands and small gravels.

2.2.2 Site and Hydraulic Constraints

The channel design was subject to two primary site constraints:

- In-situ elevations of the remaining storm drain segments of the 72-inch storm drain pipe at the upstream and downstream ends of the project reach; and

- Existing topography alongside Halleck Street and Girard Road, paralleling the channel to the west and east.

The pipe invert elevations dictated the maximum slope available for the restoration channel reach. In addition, the topographic differences between the low-lying new channel and the existing roadways and associated land uses in the overbank areas imposed relatively steep transitional slopes, particularly toward the downstream end of the reach. Here, existing Buildings 225, 226 (west side) and 1030 (east side) prevented the incorporation of broader floodplains into the channel design. This narrowing of the available channel right-of-way essentially mandated the use of a straight channel alignment over the lower 80 to 100 feet of the reach. This, in turn, influenced the sinuosity and alignment of the remaining upstream channel.

A third, less severe constraint on the channel design was the presence of a low topographic bench which is inhabited by a grove of large redwood trees. This constraint did not force adjustments to the preferred channel alignment and was easily integrated into the grading plan as a mid-level terrace feature.

2.2.3 Channel Design

The channel design was developed using principles of applied fluvial geomorphology and hydraulic engineering. Based on the available channel gradient, valley slope, and alignment constraints noted above, and the intention to include a mix of on-site habitats, Clearwater generated a channel design with the following characteristics:

- A moderately sinuous channel, with a sinuosity (i.e. valley slope/channel slope) of 1.4 and a bed slope of 2.2 percent;

- A hybrid low-flow channel, flood terrace and floodplain cross-section with a low flow-channel bottom width of 3.0 feet (straight reach), side slopes of 2.5:1, and 3 to 4 feet wide low terraces for the straight reach cross-section;
- Rapid-pool assemblages spaced at an average distance of 60 feet (4 bankfull widths);
- Flanking floodplains and variable depth wetlands along the upper 370 feet of the reach, and upper transitional slopes of 2.8:1 or milder;
- A low natural material revetment extending along the outer radii of the principal channel meander and higher revetments along the lower, narrow channel reach and immediately adjacent to the upstream storm drain outlet; and
- Reinforced concrete headwall and wingwall structures to stabilize the storm drain-to-channel transitions at the upstream and downstream ends of the channel; the upstream drain outlet includes a stilling pool.

Figures 4 and 5 show the design grading plan and cross sections, respectively. The design channel longitudinal profile and cross-sections, as well as details of typical straight and meander reach cross-sections, natural material revetments, rapid-pools and the headwall structures are included in the construction plans and specifications.

2.2.3.1 Geomorphic and Hydraulic Characteristics

The channel was designed to convey water and sediment discharges over the range of expected flows without excessive scour or deposition. This design approach is founded on the observed principle that stable natural channels form in accordance with the flow regime, watershed and valley characteristics, bed and bank materials, and sediment and debris load. Geomorphic characteristics of the design channel include a width-to-depth ratio (i.e. bankfull width/mean depth at bankfull discharge) of 23, an entrenchment ratio (flood prone area/bankfull width) of 1.9, and a sinuosity of 1.4. Applied to an overall reach gradient of 2.2 percent, the restoration channel was classified as a “B5” channel per the Stream Classification System *(Rosgen, 1996)*.

This channel type typically features a rapid-pool morphology, which in the present case has also been incorporated into the design. The rapids and their associated pools provide for greater complexity in the channel bed form and should supplement and enhance amphibian habitat within the reach. The restoration channel gradient is also appropriate within the valley context and slope (3 percent).

Typical meander sub-reaches in mild to moderately sloping channels exhibit an adjusted channel geometry to reflect the natural tendency of the channel to narrow its bottom width and build a point bar feature on the inside of the bend. Grading of the point bar feature assists the channel in maintaining the desired alignment. A deeper, scoured thalweg normally forms along the outer edge of the meander. This results from the helical-type flow pattern in the bend. While this scoured thalweg is not shown on the plan drawings, it will be constructed under the supervision of the project hydrologist.

Normal depth computations were conducted to verify the flow velocities for the design channel cross-section in a typical straight sub-reach. For the 2-year and 100-year flood discharges, the flow velocities were computed at 4.8 and 6.4 feet per second (ft/sec), respectively. At higher downstream tide levels, higher magnitude flood flows will produce some backwater effects through the lower portion of the restoration reach. Hence, the upper end of the velocity range is likely somewhat of an overestimate. FLOWMASTER *(Haestad Methods 200, version. 6.1, 2000)* computer program input and output data for the normal depth runs are attached in the Technical Appendix A.

Flood water surface profiles were not conducted for the new channel. Since the channel versus overbank elevation differentials were substantial (10 to 20 feet) and associated computations confirmed that sufficient headwater was available at the downstream storm drain to pass the 100-year flood discharge, flooding was not considered an issue.

For purposes of channel stability, the bankfull cross-section was confirmed by checking the ability of the 2-year bankfull discharge to mobilize the d_{50} sediment fraction. Accordingly, the bed shear stress was

computed for the straight reach channel cross-section at the estimated bankfull discharge of 60 cfs. The equation for bed shear stress, τ is:

$$\tau = \gamma * R * S$$

where:

τ	=	bed shear stress (pounds per square foot [psf])
γ	=	unit weight of water (62.4 psf)
R	=	hydraulic radius, feet
S	=	water surface slope (approximately equal to bed slope)

For the bankfull discharge, the bed shear stress was computed at 0.99 psf, which is sufficient to mobilize large gravels (e.g., 2.5 inches diameter). This result was acceptable when compared to the observed bed sediments a short distance upstream from the site, which consisted principally of coarse sands and small gravels. To facilitate the sizing of anchoring boulder elements for the rapid-pool weirs and the counter-weighting elements of the natural material revetments, bed shear stress was also computed for the 100-year flood discharge of 241 cfs. The computed shear stress value of 1.8 psf indicated potential mobilization of large cobbles with diameters of approximately 7 inches.

2.2.3.2 In-Stream Perennial and Off-Stream Seasonal Wetlands

Recent trenching excavations conducted by the Trust during May 2004 indicated a local water table elevation toward the downstream end of the project reach of approximately 6.0 feet North American Vertical Datum 1988 (NAVD 88). Since the invert elevation of the downstream inlet to the lower 72-inch storm drain segment is approximately 4.0 feet NAVD 88, groundwater could be intercepted during the excavation activities. The short-term effect will be a lowering of the local water table. Even with the lowering, however, groundwater levels are expected to be at or just below the channel bed in non-drought years. These elevated groundwater levels will support the establishment of in-stream wetland plants as well as hydrophilic riparian species (e.g. willow) on the flood terraces and floodplain areas.

Two seasonal wetlands have been incorporated into the design channel along its middle sub-reach. The broad nature of the channel cross-section through this more sinuous reach enabled Clearwater to include variable depth wetlands created via construction of relatively discrete earthen berms. Both wetland areas will be constructed with vegetated, un-reinforced overflow (i.e. inlet/outlet) weirs. Interior and exterior wetland grades are mild, ranging from 5:1 to 8:1. Wetland bottom elevations were set to 0.0 to 0.7 feet above the adjacent restoration channel thalweg. With construction of a perimeter berm at a constant elevation, this bottom profile results in maximum ponding depths of roughly 1.3 feet during the bankfull event. During higher magnitude flood events (e.g. greater than 10-year flood), the entire floodplain including the wetland ponds will be inundated. Given the elevation of the water table evidenced in the exploratory site excavation (approximately at elevation 6.0 feet at north end of Site), groundwater underlying the wetlands should rise to or very near the wetland bottom during the winter and early spring. This will facilitate the establishment and maintenance of wetland plants within the ponds, which could dry out by mid-summer, depending on the seasonal fluctuation in the local water table.

2.2.3.3 Biotechnical Channel Stabilization

While informed geomorphic design assists greatly with the development of a stable channel morphology, the extended period of establishment for densely rooted riparian vegetation warrants the installation of minor stabilizing elements to decrease the risk of significant bank erosion and channel instability. The natural material revetments prescribed as part of the restoration design are depicted in plan form and elevation on Figure 7. Due to the small scale of the installations over the bulk of the new channel reach, log and/or root wad elements will be of accordingly small diameter (e.g. 0.75 to 1.5 feet). These woody elements will be counterweighted by embedded boulders and inter-planted with willow cuttings or other riparian species as specified in the Trust revegetation plan.

Log and root wad diameters, as well as the size of the counter-weighting boulders, will be increased both at the upstream storm drain outlet and in the narrow downstream reach in the approach to the storm drain inlet. At the upstream drain outlet, exit velocities from the storm drain system will be high (e.g. 15 to 20 ft/sec).

This exit velocity range was estimated for the 72-inch pipe using Manning's equation for full pipe flow at a slope of 2 percent. The flow will need to be diverted into the channel, which will assume a different alignment than the extracted storm drain segment. To reduce the effect of erosive forces against the more steeply sloping west bank and to train flows to the new channel, higher natural material revetments with larger log and boulder elements will be used.

In the narrow approach to the downstream storm drain inlet, the flood terraces and floodplains that serve to dampen the erosive forces of flood flows in the remainder of the reach are absent due to the constrained channel right-of-way. Higher revetments, including a second tier of revetment or a structural retaining wall above the 100-year flood stage, were incorporated into the design to reduce the localized risk of bank instability. Inclusion of these revetments also created an acceptably mild upper slope (2.8:1 max.) as a transition to adjoining overbank/sidewalk areas. In both the upstream and downstream transitions, the higher revetment structures will be largely hidden from view within a few years by the subsequent establishment of planted and volunteering riparian vegetation.

2.2.4 Headwalls, Stilling Basins and Appurtenant Structures

The excavation and removal of approximately 430 feet of the 72-inch storm drain pipe requires the incorporation of reinforced concrete headwalls and wingwalls to structurally stabilize the ends of the remaining storm drain segments and to provide for a smooth hydraulic transition to and from the new channel. Details of the upstream and downstream headwall complexes are presented on Figure 6. The design height of the upstream and downstream headwall structures above the local channel grade was set at 8.0 feet. This height provides both sufficient structural support to the storm drain barrel and acceptable transition slopes to adjoining sidewalk/walkway sections. At the upstream end of the reach, the resulting maximum transition slope of 2.5:1 can be constructed without affecting the integrity of the historic wall that parallels the north sidewalk along Lincoln Avenue. Specifications for the construction of the headwalls and their companion 45 degree wingwalls, including steel reinforcing requirements, are described in Caltrans "Standard Plan D90A with Wingwall Type 'A' " included in Appendix A. The concrete itself will be treated with a coloring and

then lightly sandblasted to improve its overall aesthetic in accordance with standard practice in historically significant areas of the Presidio.

The storm drain outlet design includes a stilling basin, which will extend longitudinally 10 to 15 feet downstream from the drain outlet. The bottom and sides of the basin will be composed of variable-sized boulders, roughly 1.5 to 3.0 feet in diameter. Design basin depth will be 2.0 feet, and the basin will be asymmetrically shaped to facilitate the turning of flows into the new channel. The boulders will be embedded into the substrate to 60+ percent of their diameters. Fine to coarse gravels and coarse sands will be imported to fill the interstitial spaces in the boulder matrix, especially in the eastern edge of the basin outside of the zone of maximum scouring forces. These smaller sediments can be planted with emergent wetland and riparian vegetation. As outlined in the above discussion of biotechnical stabilization measures, the western edge of the stilling basin will be more strongly fortified using large diameter logs and boulders.

3.0 CONSTRUCTION OPERATIONS

Construction operations at Fill Site 6A necessary to remove the fill material and to construct a new channel are described in the Clean Closure Work Plan and Plans and Specifications *(MACTEC, 2004)* that are currently being reviewed and approved by the DTSC.

3.1 Remediation Contractor

The remediation contractor will be selected through a competitive bid process. The Trust has experience with similar projects completed in recent years. The contractor will be required to have prior experience with similar projects. A general engineering license with hazardous substance removal and remedial action certifications will be required. Haul trucks that handle hazardous or regulated waste will be required to have proper licenses.

3.1.1 Fill Removal Operations

The following operations have been performed or are scheduled to be performed as part of removal of fill material prior to restoration:

- Initial Site Preparation: In February 2004, the Trust performed initial site preparation work that consisted of removing selected non-native vegetation to comply with the Golden Gate National Recreation Area (GGNRA) requirements and the Presidio restrictions on vegetation removal during bird nesting seasons.

- Removal of Inactive Utilities: After the remedial contractor has been selected the first phase of construction activities will consist of removal of inactive utilities and the relocation of active utilities located within the site boundary. This work will be performed by the remediation contractor or a qualified subcontractor, and will be overseen by the Engineer and by representatives of the Trust's Utility Department.

- Site Preparation, Sampling, and Fill Excavation: Perimeter fence and traffic control signs will be installed. The contractor will mobilize to the Site, and clear existing vegetation. The redwood trees located in the eastern portion of the Site will be preserved. The contractor will sample and analyze the soil for disposal purposes and construct stockpiles for loading into trucks. If present, remnant floor slabs from former buildings will be broken up and separately stockpiled for off-site recycling. The contractor will excavate soil and debris (Figure 3), estimated to be approximately 45,000 cubic yards. Trucks will be decontaminated before entry on public roads. Dust control will be conducted on a daily basis. Trucks must follow ingress/egress routes prescribe in the traffic and signage plan included in the FS 6A Clean Closure Work Plan *(MACTEC, 2004*).

- Storm Drain Pipe Removal: The 72-inch storm drain pipe will be removed in segments, broken up, and recycled off-site. Water in the pipe will be handled as described in Section 3.2.1.

3.1.2 Construction Phase SWPPP and Erosion Control

A construction phase SWPPP has been prepared and will be implemented during construction. The Trust will issue a notice of intent (NOI) under National Pollution Discharge Elimination System (NPDES) general permit for storm water. The contractor will be required to prevent water, flowing in the 72-inch storm drain pipe, from coming in contact with waste materials by installing a temporary drain pipe or diversion weir and pump as described in Section 3.2.1. The SWPPP will remain in-force during the fill removal, construction of the new channel and initial site restoration work, and through the first wet season after completion of channel construction. After that, the SWPPP will be closed and a program of long-term monitoring of erosion, establishment of vegetation and hydraulic performance will be undertaken as described in Section 4.2.

3.1.3 Excavation Safety and Protection of Existing Structures

Known historic structures include a stone wall along Lincoln Boulevard, the concrete wall at Halleck and Lincoln, and Buildings 222, 223, 225 and 226 along the west side of the Site and the slope east of Buildings 224 and 225. Excavations are not expected to encroach within approximately 25 feet of historic structures,

with the possible exceptions of Buildings 225 and 226. Historic structures predate placement of waste fill on the Site, hence stability of the historic structures is not expected to be dependent on the presence of fill. If excavations must be moved closer, extreme care will be exercised, and digging will be supervised by an experienced engineering geologist or geotechnical engineer at the direction of the Trust.

3.1.4 Archeological Considerations

The Trust has successfully completed numerous excavations in archaeologically significant areas. At Fill Site 6A, remedial activities will be monitored by Trust archaeologists as needed. If a former railroad spur is exposed, its significance will be evaluated. Artifacts will be collected and preserved, if encountered. The remediation contract includes provisions to stop or move contractor operations as needed to evaluate and preserve historical resources.

3.2 Watershed/Clearwater

3.2.1 Channel, Outlet, and Inlet Construction

The first step in channel construction, which is to establish a stream flow diversion, will be completed by the remediation contractor prior to removing the 72-inch storm drain pipe. Before the 72-inch storm drain pipe can be removed, a stream diversion will be established according to the Storm Drain Relocation Plan provided by the remediation contractor, which will be subject to approval by the Trust. The Trust will facilitate communication and coordination between the remediation contractor and restoration consultants, Watershed Science and Clearwater to ensure that the stream diversion is acceptable to the parties. The stream diversion will be installed to catch the flow at the outfall of the storm drain at the upstream end of the project and convey the flow to the downstream end of the project where it will be discharged to the remaining portion of the 72-inch storm drain.

A separate dewatering pond will be constructed at the beginning of Phase I at the downstream end of the project reach. This pond will be used for dewatering purposes during remediation construction. The construction documents for phase I *(Technical Specifications; MACTEC, 2004*) indicate that water

accumulated in the excavation will be pumped to the sanitary sewer until Phase I has been completed. After the contaminated soil and related seepage are removed and Phase I work is completed, the pond will be fitted with a sandbag weir overflow and will function during the Phase II restoration work as a settling basin for groundwater seepage entering the construction area. The clarified effluent will not exceed influent turbidity levels.

The second step in channel construction is to control groundwater seepage. Excavation is expected to extend about 4 feet below the water table (based on the excavation performed in June 2004 to the 72-inch pipe), creating a seepage face at the bottom of the excavation. Groundwater will enter the open excavation as saturated pores along the seepage face drain into the excavation. The existing water table will then re-equilibrate to a new gradient to the stream. Groundwater entering the excavation will flow downstream to the dewatering pond as described above and will be pumped to tanker trucks for disposal at an approved landfill or treatment facility.

After the diversion and groundwater seepage control facilities are in place, channel excavation will be initiated. Specifications require that the grade after removal of fill soil and debris be left to plus or minus 1 foot by the mass excavation contractor; the finished channel tolerance is plus or minus 0.1 foot.

The final grading prior to restoration activities will be field-supervised by the restoration hydrologist, who will oversee the following activities:

- Set the channel grade and alignment;
- Supervise placement of channel stabilization and rapid-pool weir structures;
- If necessary, place and lightly compact appropriate bed sediment in the bankfull channel zone ;
- Construct outlet and inlet structures (e.g. headwalls and wingwalls) surrounding and transitioning the existing pipe to and from the new channel

- At the upstream storm drain outlet, construct the dissipator pool and adjoining west bank natural material revetment to stabilize the west bank and to guide floodflows eastward into the upper restoration channel reach. Boulders used in the dissipator pool and natural material revetments will be weathered, with worn (not fractured) surfaces. Fresh fractures are allowable provided they can be buried in the channel material and not exposed; and

- Backfill the channel bed and banks with native onsite material, including overseeing compaction to prevent material from winnowing under high flows and to assure that compaction will not restrict root penetration and growth, or impede percolation.

After the channel grading has been completed, the diversion will be removed and all materials not scheduled to remain as post-construction erosion control features will be removed from the Site.

3.2.2 Transition from Construction Phase to Post-Construction Erosion Control

When the channel flow is returned to the new channel and the diversion has been removed, the construction phase will be completed and the erosion control phase will begin. An erosion control seed mix will be applied to upland areas away from the channel. The erosion control seed mix for erosion control will be approved by the Restoration Ecologist to assure that it does not have a weedy affect on revegetation. All native seed will be Presidio generic stock. The seed selected for the erosion control mix will be broadcast (rate depending on species) and raked in. All bare ground will be covered with certified weed-free rice straw at a rate of 2,000 pounds per acre. Slopes steeper than 2:1 will be covered with erosion control blankets, such as North American Green C0-125BN or equal, with organic fiber netting. Erosion control blankets will be stapled according to manufacturer's recommendation.

The Trust's restoration and remediation Project Managers will work closely together to assure that all erosion control measures are regularly assessed for integrity and effectiveness during the remediation process. As the

transition to restoration takes place, erosion control monitoring responsibilities will be taken over by the restoration Project Manager.

4.0 POST CONSTRUCTION ACTIVITIES

4.1 Riparian and Landscape Zone Planting Program

The created habitats will be arranged with the bulrush wetland community at the lowest parts of the site along the stream corridor. The lowest portion of the channel will feature a broad expanse of heterogeneous topography including pools and saturated soils. The Halleck Street side (west edge) will be approximately a 2:1 (this depends on the wall) 2.1:1 with no wall, 2.5:1 with wall slope. The Girard Road side (east) will have a less-steep slope. Wetland vegetation will grade into an arroyo willow community on the lowest parts of the slope and, as the slope rises away from the corridor, then into a coast live oak riparian community, which will grade into a coyote brush community. May and Associates, specialists in riparian restoration projects, have been contracted by the Trust to implement the planting of native species at Fill Site 6A. Six piezometers will be installed to gauge sub-surface water levels prior to planting to assure better success of species selected for planting in specific areas. Table 1 lists species to be planted, and Figure 8 shows the rough layout of the following plant communities:

- Bulrush Wetland Community – Dominated by emergent vegetation in open water and small-stature plants in saturated soils (height: 2 to 3 feet). Rushes (*Juncus spp.)* will likely dominate, but the community will also include sedges (*Carex spp*.), spikerushes (*Eleocharis spp*.) and bulrushes (*Scirpus spp.).* Rooting depth is 0 to 20 inches. This zone of emergent vegetation will be 1 to 10 feet across. The lowest spots are open water or saturated soils.

- Arroyo Willow Community – Large shrubs and small trees dominate (overstory height: 5 to 25 feet). Willows (Salix spp.), young oaks (*Quercus agrifolia*), wax myrtles (Myrica californica), and red-osier dog wood (*Cornus sericea ssp. sericea*) dominate the shrub layer and Freshwater Wetland vegetation grades into the understory and open areas. Rooting depth is 10 to 20 inches but may increase to 36 inches in areas underlain by Colma formation soils.

- Coast Live Oak Community – An oak (*Quercus agrifolia*) dominated hardwood assemblage (height 10 to 25 feet), where species requiring shallow groundwater do not thrive. Other common woody species include California buckeye (*Aesculus californica*), California bay (*Umbellularia californica*), and holly-leaved cherry (*Prunus ilicifolia*). Rooting depth is greater than 36 inches.

- Coyote Brush Community – A mix of many shrub and sub-shrub species including coyote brush (*Baccharis pilularis*), toyon (*Heteromeles arbutifolia*), yarrow (*Achillea millifolium*) dominate (height mostly 2 to 5 feet with occasional small trees greater than 15 feet). This community represents an upland habitat and rooting depths were not considered.

The following communities will be installed and managed by the Trust:

- Redwoods - Six existing redwood (*Sequoia sempervirens*) trees will be retained (height: currently less than 60 feet but can grow greater than 300 feet). All other non-native species will be removed from the area and the trees may be pruned to enhance visitor experience. An understory of native shrubs and wildflowers will be planted under the redwoods.

- Landscape Zone – The landscape zone will be planted and designed in accordance with the Presidio Trust's Vegetation Management Plan and the Presidio Trails and Bikeways Master Plan. Species will be selected to enhance the visitor experience and not pose a risk to the riparian natural area. The Presidio has rigorous criteria that determine what species are allowed in the landscape zone.

4.2 SWPPP Closure and Transition to Long-Term Erosion Control and Monitoring

The SWPPP will govern erosion control and monitoring during the remediation/construction phase, the restoration phase, and during the first wet season after construction had been completed. The remediation and restoration contractors will adhere to the SWPPP or propose construction phase modifications. Proposed modifications will require approval by the Trust. After completion of the fill removal and construction of the new channel, compliance with the SWPPP will become the responsibility of the Trust. The SWPPP will be

terminated by the Trust by filing a Notice of Termination (NOT) with the RWQCB. The Trust expects to file the NOT after the end of the wet season following completion of the new channel. Subsequent erosion monitoring will be carried out under the Erosion Monitoring Plan (described below) until the Site has been sufficiently re-vegetated so that erosion is no longer an issue.

4.3 Long-Term Erosion Monitoring

Long-term erosion monitoring will be according to the Erosion Monitoring Plan included in Appendix C. This Erosion Monitoring Plan was also included in the Clean Closure Work Plan (*MACTEC, 2004*) previously submitted to DTSC for review. The Erosion Monitoring Plan provides for a gradual, monitored transition from the end of the construction phase to the final, stable, restored site.

Monitoring of erosion and the condition of and need for best management practices (BMPs) is part of the erosion monitoring plan will be occur until the site has been sufficiently re-vegetated that erosion is no longer an issue. Anticipated maintenance activities include routine maintenance of BMPs, side slopes, storm drain out- and inlet structures, weed abatement, and temporary installation of erosion control structures during winter rains (if necessary). Maintenance activities will be undertaken as necessary to minimize and control erosion.

Inspections performed during the monitoring period will be documented by the Trust's representative. These reports will be kept in the project file at the Trust's offices at 1750 Lincoln Boulevard. Inspections performed during the plant restoration and post-restoration phases will be recorded and transferred to the Trust project file upon completion of the erosion monitoring.

4.4 Vegetation Establishment Monitoring

Throughout the restoration process, non-native species will be assessed by the Trust's restoration Project Manager. Any actions taken will be by the Project Manager or supervised by the Project Manager. Community volunteers, contracted employees, or staff members (from the Trust, the National Park Service [NPS], or the Golden Gate National Parks Conservancy) will perform the work. The Site will be monitored

by the Trust Project Manager for vegetation establishment in the spring after planting. This monitoring effort will provide a picture of both the success of native plantings and also the presence of invasive species. This monitoring will be repeated in year two and periodically thereafter until the plant community is established. The data will be recorded using appropriate data sheets and entered into the restoration database, housed with the NPS and jointly maintained by the Trust, the NPS, and the Golden Gate National Parks Conservancy. The data will be used internally to modify future restoration efforts and may be presented at a scientific meeting.

Six piezometers will be established across the restored channel and associated with specific native plants. The success of these plants will be closely monitored to direct future planting efforts. These piezometers and plants will be monitored seasonally for three years to assess the Site's hydrologic period. This information, in conjunction with plant establishment information associated with each piezometer, will be presented at a meeting with the Trust and NPS. The records will reside with the Trust's Restoration Project Manager and copies will be retained in the project files at 1750 Lincoln Boulevard at the Presidio.

4.5 Hydraulic Monitoring

Clearwater staff will monitor the new channel reach annually for 3 years after completion of the project. The monitoring will include: 1) visual inspection of all project construction features (e.g. weirs and natural material revetments), and 2) survey of 3 to 4 channel cross sections, including adjoining floodplains. The Site inspection will note any changes in channel conditions that may impact the hydraulic performance of the restored reach. Temporary benchmarks will be installed at each of the surveyed cross sections, to secure the cross section locations for subsequent surveys. The survey will be suspended after three years if the channel remains stable and surveyed cross sections remain relatively constant. Clearwater will prepare an inspection report that contains the results of their monitoring. This report will be kept in the project files at 1750 Lincoln Boulevard at the Presidio.

5.0 REPORTING

5.1 Remediation Phase

The Trust will prepare a construction completion report for the remediation phase of the project. This report will be submitted to DTSC. The report will describe the project up through removal of the fill and 72-inch drain pipe and rough grading. The report will document that the remedial objectives of the project, including achievement of soil cleanup levels in confirmation soil samples and will include a final record survey showing the rough grading topography.

5.2 Restoration Phase

Vegetation establishment and hydraulic monitoring will be performed for at least three years following completion of channel construction. Vegetation establishment will be reported in an annual meeting with the Trust and NPS. Hydraulic monitoring will be submitted in yearly annual reports that will be kept on file in the Trust's project office at 1750 Lincoln Boulevard at the Presidio.

As-built drawings showing the new channel and its appurtenant structures will be produced after completion of the site restoration. The as-built drawings will be kept on file in the Trust's project office at 1750 Lincoln Boulevard at the Presidio.

6.0 SCHEDULE

The estimated schedule to perform the restoration work for Fill Site 6A is included in Appendix B. This schedule is subject to change.

7.0 REFERENCES

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Rosgen, D. 1996. <u>Applied River Morphology</u>. Wildland Hydrology (Self-Published), Pagosa Springs, CO.

Treadwell & Rollo, 2004, *Remedial Action Plan for Fill Site 6A and Baker Beach Disturbed Areas 3 and 4*, March 2004

TABLES

Table 1
Plant Species for Planting Zones
Fill Site 6A Restoration

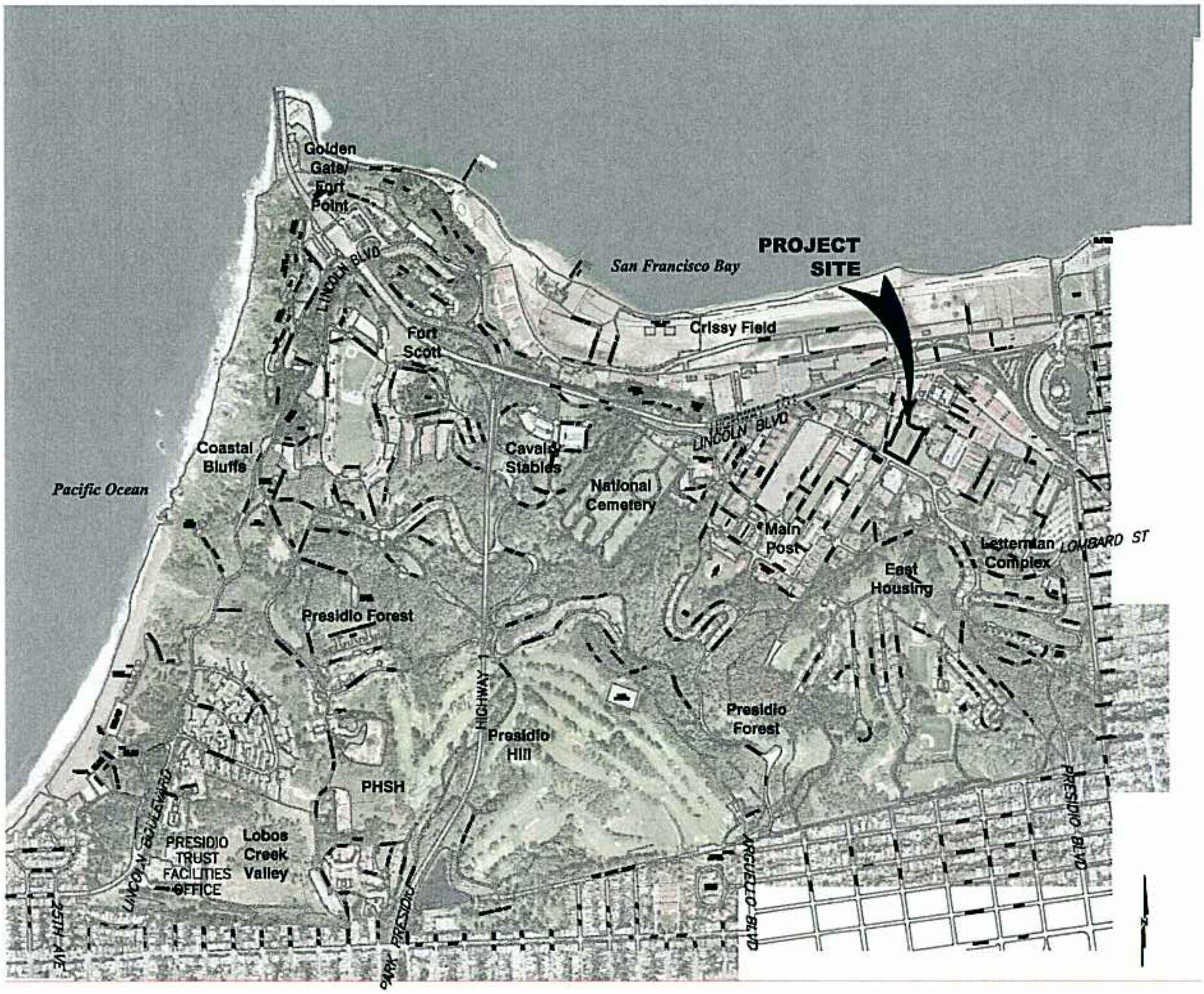
Species	Common Name
Acaena pinnatifida var. californica	*California acaena*
Achillea millefolium	
Aesculus californica	*California buckeye*
Anaphalis margaritacea	*pearly everlasting*
Angelica hendersonii	*coast angelica*
Artemisia californica	*California sagebrush*
Artemisia douglasii	
Aster chilensis	*common California aster*
Athyruim filix-femina var.cyclosorum - spore	*lady fern*
Baccharis pilularis	*coyote bush*
Bromus carinatus var. maritimus	
Calystegia purpurata ssp. Purpurata	*hilside morning-glory*
Camissonia ovata	*suncup;golden eggs*
Carex densa	*dense sedge*
Carex obnupta	*slough sedge*
Carex subracteata	*small bract sedge*
Castilleja affinis ssp. Affinis	
Ceanothus thyrsiflorus	*coast blue-blossom;California lilac*
Cornus sericea	*red-stemmed dogwood*
Corylus cornuta	*California hazelnut*
Dantonia californica var. californica	*California oatgrass*
Deschampsia cespitosa	*tufted hairgrass*
Eleocharis macrostachya	*spikerush*
Elymus glaucus ssp. Glaucus	*blue wildrye*
Ericameria ericoides	
Erigeron glaucus	*seaside daisy*
Eriogonum latifolium	*coast buckwheat*
Eriophyllum staechadifolium	*lizard tail*
Euthamia occidentalis	*western goldenrod*
Festuca rubra	*red fescue*
Fragaria chiloensis	*coast strawberry*
Fragaria vesca	*wood strawberry*
Heracleum lanatum	*cow parsnip*
Heteromeles arbutifolia	*Christmas berry;toyon*
Iris douglasiana - seed	
Iris longipetala - divisions	*long-petaled iris*
Iris longipetala - seed	
Juncus effusus var.brunneus	*brown bog rush*
Juncus falcatus var.falcatus	*sickleleaf rush*
Juncus lesueurii	*salt rush*
Juncus patens	*spreading rush*
Juncus phaeocephalus	*brownhead rush*
Juncus xiphiodes	*iris-leaved rush*
Koeleria macrantha	*june grass*
Lathyrus vestitus var.vestitus	*hillside pea*
Leymus triticoides	*creeping wild rye*

Species	Common Name
Lonicera hispidula	*hairy honeysuckle*
Lonicera involucrata	*twinberry*
Lupinus variicolor	
Luzula comosa	*wood rush*
Melica torreyana	*Torrey's melic grass*
Mimulus aurantiacus	
Monardella villosa	*Franciscan coyote mint*
Myrica californica	*California wax myrtle*
Nassella pulchra	*purple needle grass*
Oenanthe sarmentosa	*water parsley*
Phacelia californica	
Phalaris californica	*California canary grass*
Polygonum punctatum	*water smartweed*
Polypodium californicum - spore	*California polypody*
Polystichum munitum - spore	
Potentilla anserina ssp.pacifica	silverweeed
Pteridium aquilinum var.pubescens - spore	
Quercus agrifolia	*coast live oak*
Rhamnus californica	*coffeeberry*
Ribes sanguineum	*red flowering currant*
Rosa californica	*California rose*
Rosa californica-Divisions	
Rumex salicifolius var. crassus	*willow dock;willow-leaved dock*
Salix lasiolepis	*arroyo willow*
Salix lucida ssp.lasiandra	*shining willow;yellow willow*
Sambucus mexicana - cuttings	*blue elderberry*
Sambucus racemosa	*red elderberry*
Sanicula arctopoides	*footsteps of spring*
Satureja douglasii	*yerba buena*
Scirpus californicus	*California tule*
Scirpus cernuus	*low club-rush*
Scirpus maritimus	*bulrush*
Scirpus microcarpus	*small-fruited bulrush*
Scirpus pungens	*common threesquare*
Sidalcea malvaeflora	*checkerbloom*
Sisyrinchium bellum - seed	
Sisyrinchium californicum	*yellow-eyed grass*
Solanum umbelliferum	*blue witch*
Solidago spathulata ssp. Spathulata	*coast goldenrod*
Stachys ajugoides var.ajugoides	*hedge nettle*
Symphoricarpos albus	*snowberry*
Trifolium wormskioldii	*cow clover*
Typha latifolia	*broad-leaved cat-tail*
Urtica dioica	*stinging nettle*
Wyethia augustifolia	*mule's ear*

Checked MJH

Approved MAJ

FIGURES



MACTEC
ENGINEERING & CONSULTING
10265 Rockingham Drive, Suite 150
Sacramento, California 95827
(916) 364-0793

SITE LOCATION MAP
FILL SITE 6A RESTORATION PLAN
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
1

DRAWN	FILE NAME	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
FGH	G-LOCA.DWG	55213	MJH MAJ	30-JUNE-04	8/04

LEGEND:

33	EXISTING CONTOUR
— — —	LIMIT OF WORK

NOTE: CONTOUR ELEVATIONS ARE BASED ON NAVD 88 - US SURVEY FEET.

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SITE PLAN
FILL SITE 6A RESTORATION
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE 2

DRAWN	FILE NAME	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
FGH	G-SITE.DWG	55213	MJH MAJ	30-JUNE-04	8/04

LEGEND:

—— 33 ——	EXISTING CONTOUR
—— 11 ——	EXCAVATION CONTOUR
— — —	LIMIT OF WORK
←	EXISTING STORM DRAIN

NOTE: CONTOUR ELEVATIONS ARE BASED ON NAVD 88 – US SURVEY FEET.

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Sacramento, California 95827
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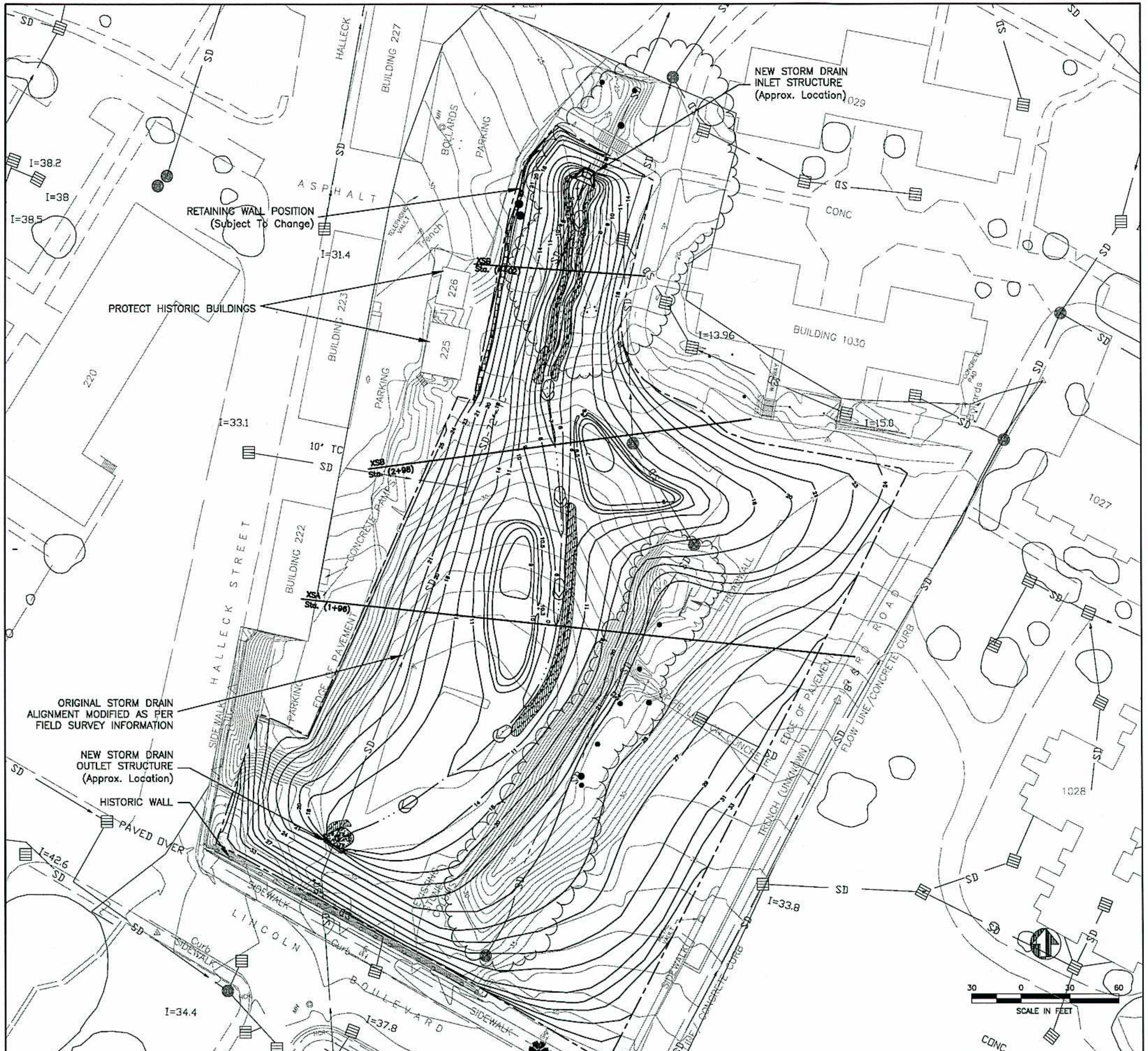
EXCAVATION PLAN
FILL SITE 6A RESTORATION
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE 3

DRAWN	FILE NAME	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
FGH	C-ECXA-REST.DWG	55213 MJH	MAJ	30-JUNE-04	8/04



LEGEND	
	Existing Contour
	Design Flow Line
	Design Contour
	Natural Material Revetment
	Grading Boundary
	Weir/Rapid-Pool
	Embedded Rock Outfall/Inlet With Wetland and Riparian Plants
	Retaining Wall

NOTE: CONTOUR ELEVATIONS ARE BASED ON NAVD 88 – US SURVEY FEET.

1 PRESIDIO TRUST: Restoration Grading Plan
1:30

REVISIONS	DATE:
Checked MJH	8/04
approved MY	8/04

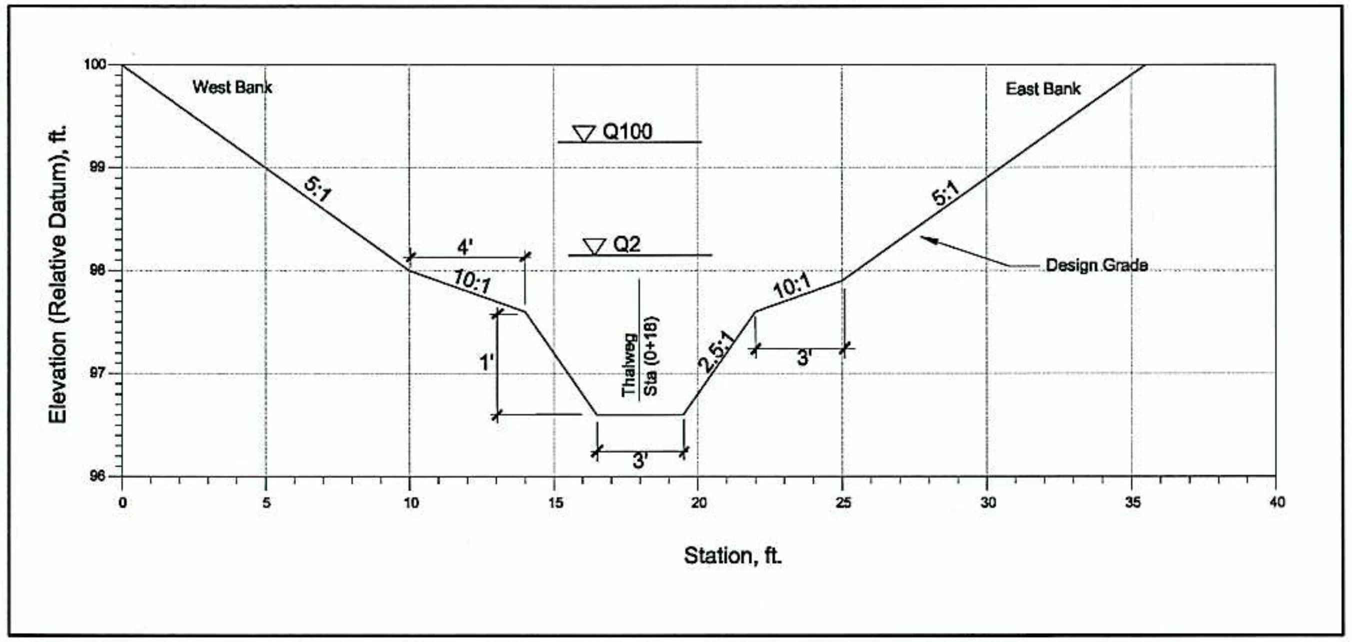
INFORMATION SOURCE:
Topographic Survey:
Chaudhary & Assoc., May 16, 2003
Stormdrain Network and Existing Features:
Presidio Trust

PROJECT:
Presidio Fill Site 6A Channel Restoration
Design Grading Plan

CLEARWATER HYDROLOGY
2974 Adeline St.
Berkeley, California
94703
Ph: (510) 841-1836

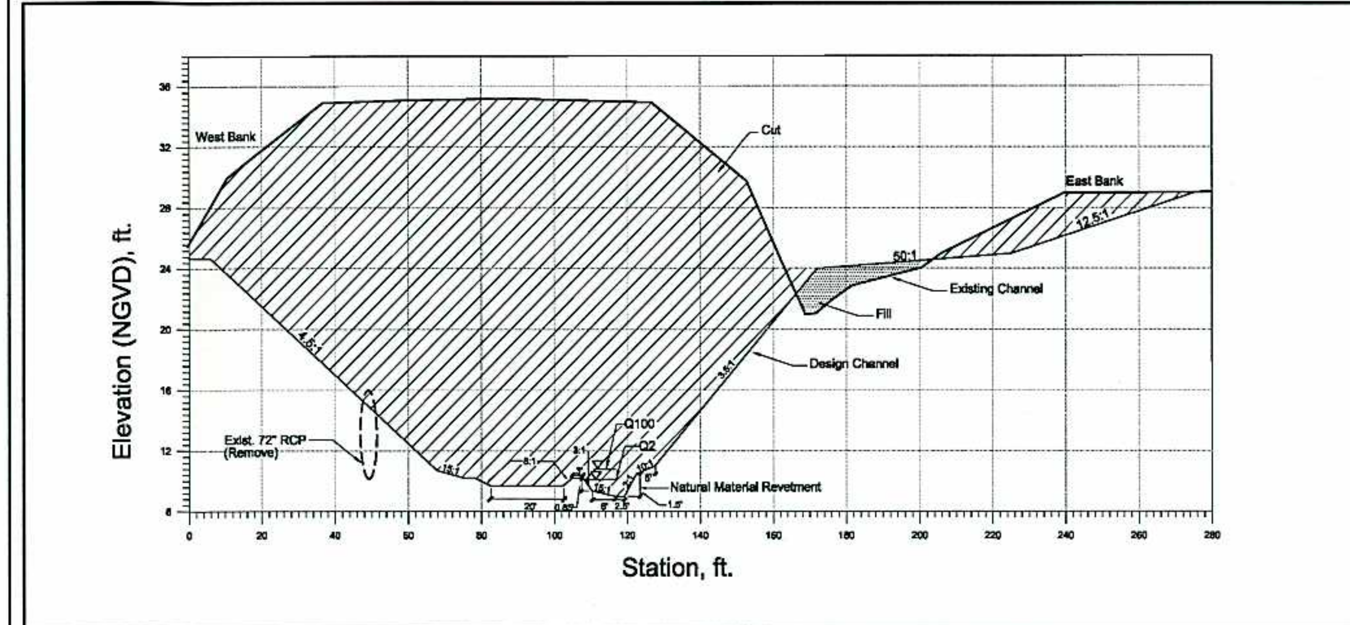
DRAWN BY: NM	PROJECT NO.: –
CHECKED BY: W.B.V.	DATE: 06-17-04
SHEET:	

FIGURE 4



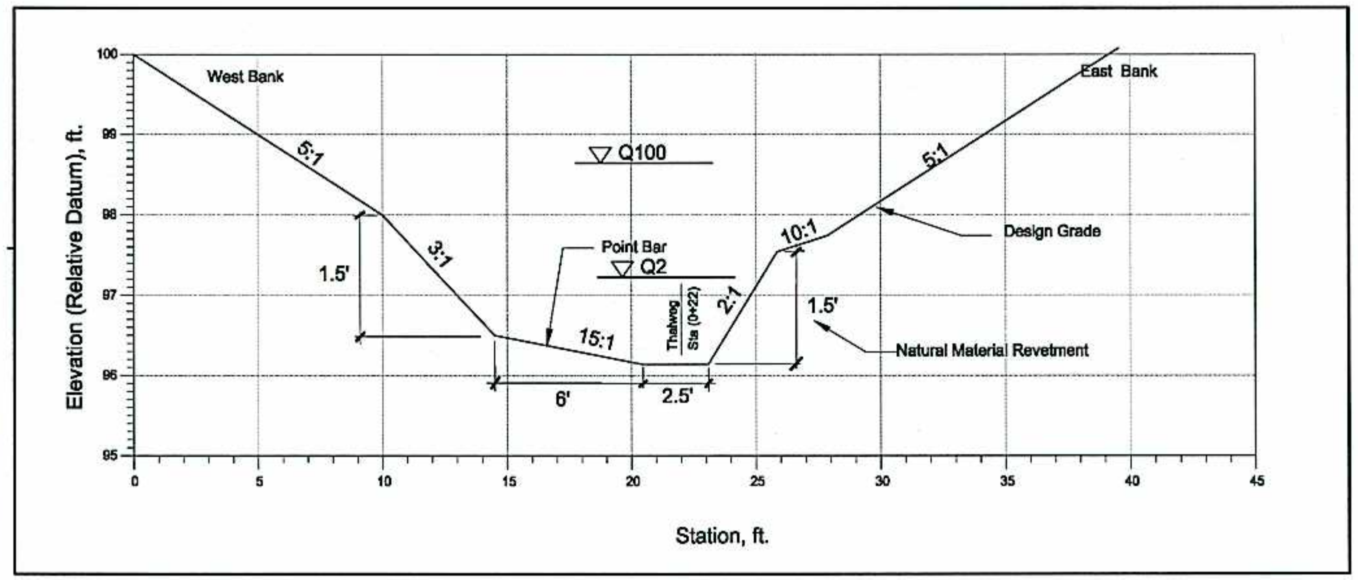
4 CROSS SECTION: Typical Straight Reach

Presidio Trust



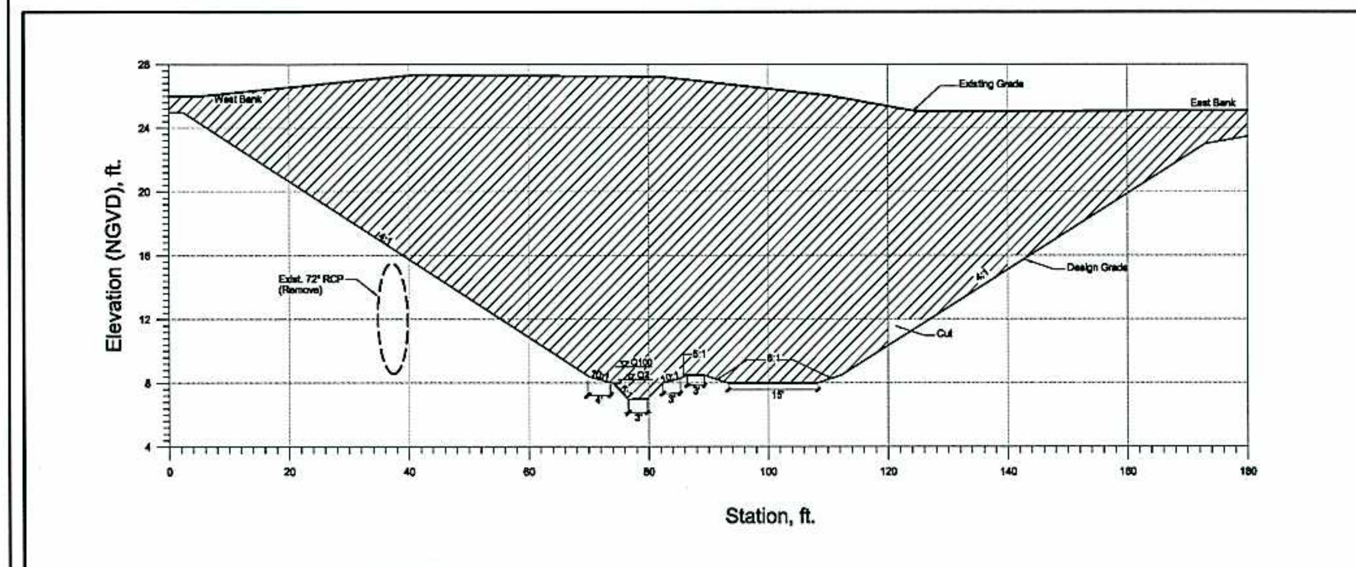
1 CROSS SECTION XS-A @ Sta. (1+96): Design Conditions

– Presidio Trust



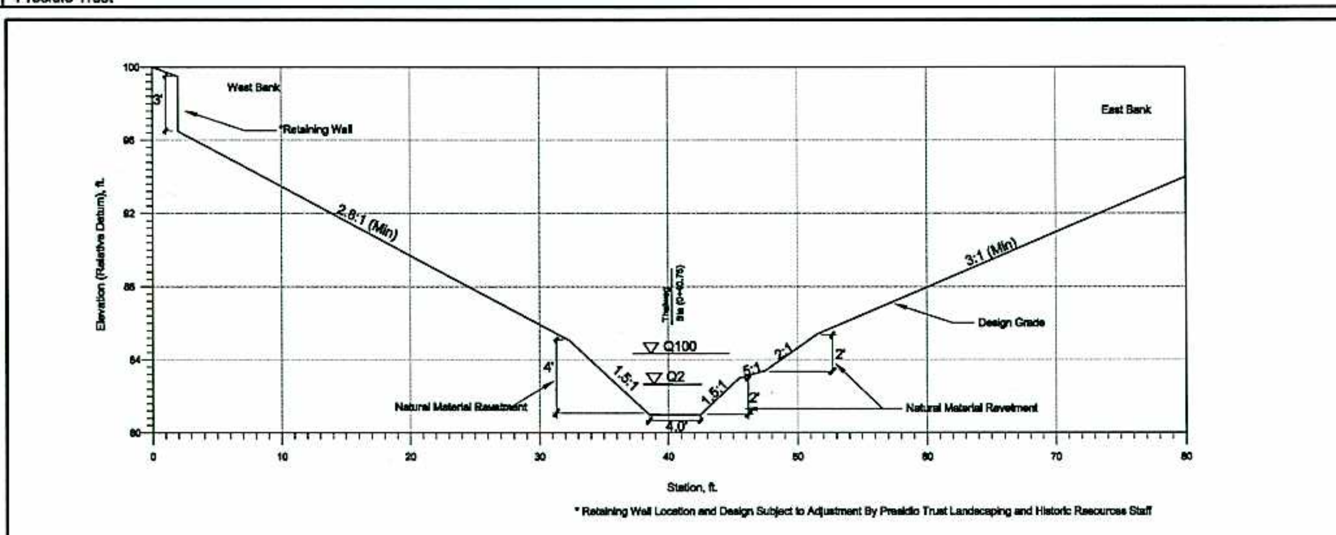
5 CROSS SECTION: Typical Meander Reach

Presidio Trust



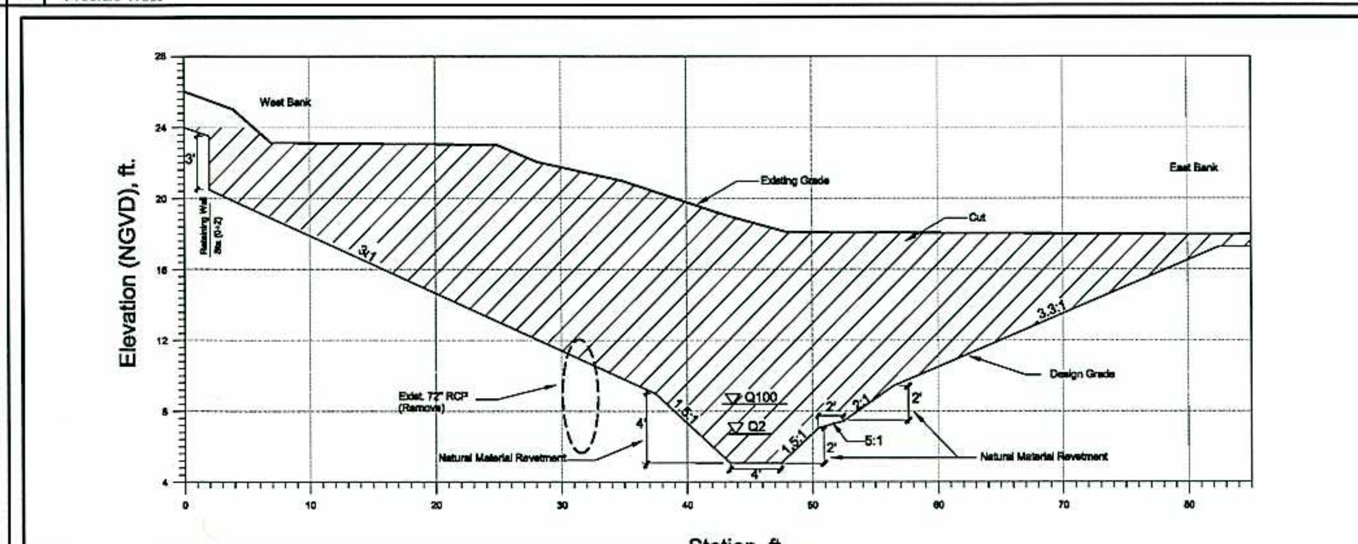
2 CROSS SECTION XS-B @ Sta. (2+98): Design Conditions

– Presidio Trust



6 CROSS SECTION: Typical Downstream Constricted Reach – Sta (3+58) to Sta (4+65)

– Presidio Trust



3 CROSS SECTION XS-C @ Sta. (4+02): Design Conditions

– Presidio Trust

REVISIONS	DATE:
△	–
Checked HJH	8/04
Approved MG	8/04

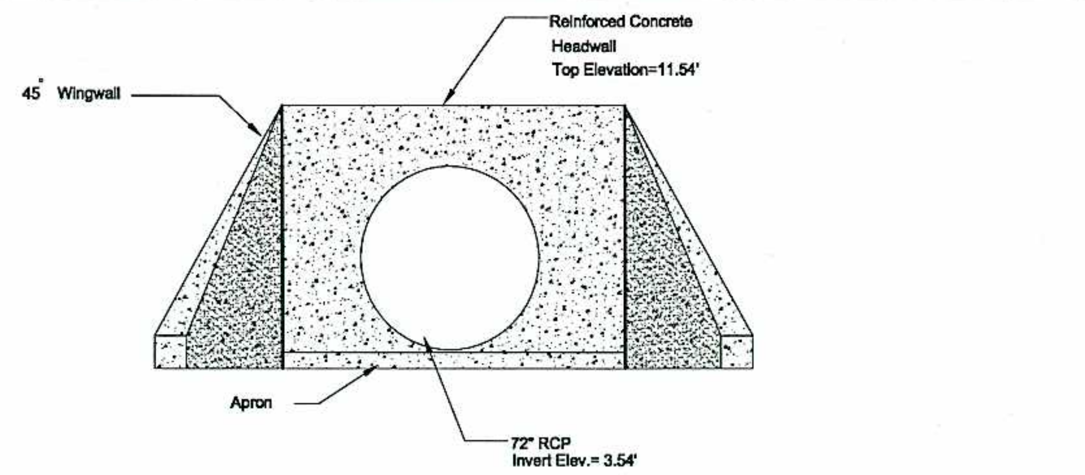
INFORMATION SOURCE:

PROJECT:
Presidio Fill Site 6A Channel Restoration
Design Channel Cross-Sections

CLEARWATER HYDROLOGY
2974 Adeline St.
Berkeley, California
94703
Ph: (510) 841-1836

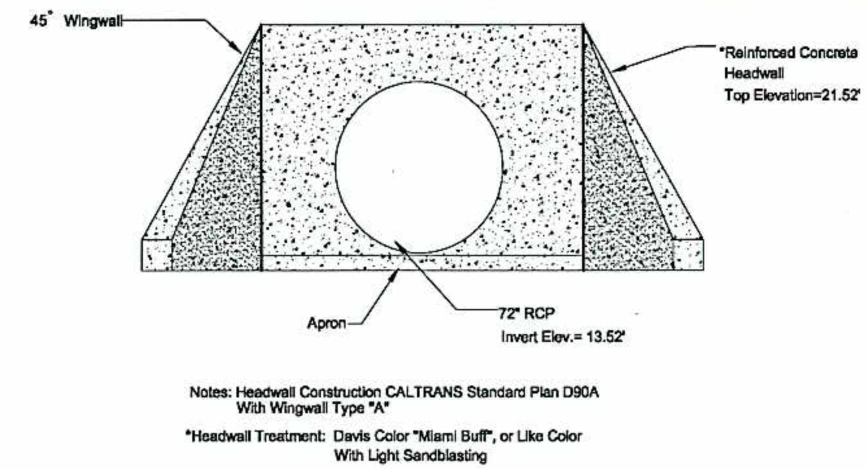
DRAWN BY: NM	PROJECT NO.: –
CHECKED BY: W.B.V.	DATE: 06-17-04
SHEET:	

FIGURE 5



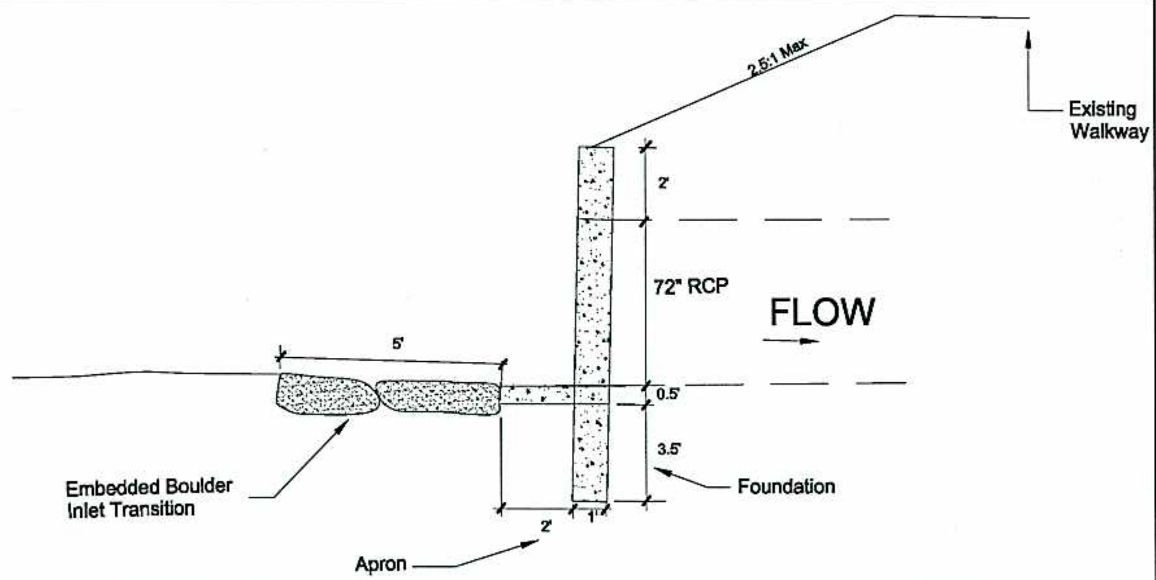
4 HEADWALL DETAIL: Sta (4+65)

Presidio Trust



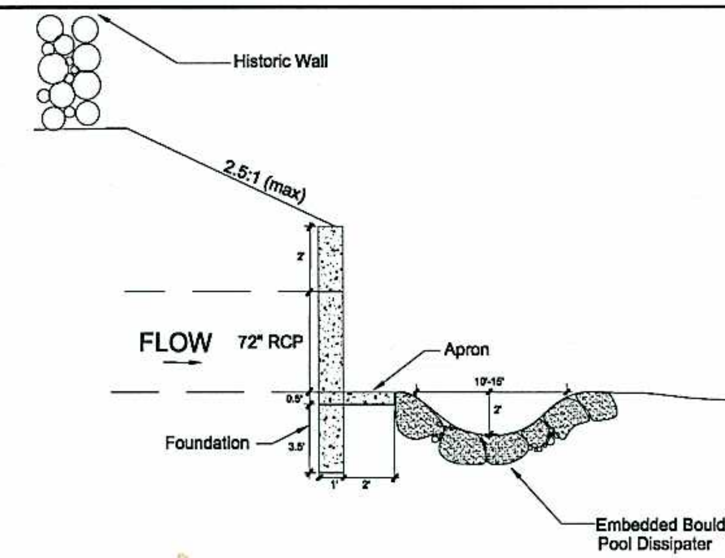
1 HEADWALL DETAIL:Sta (0+0)

Presidio Trust



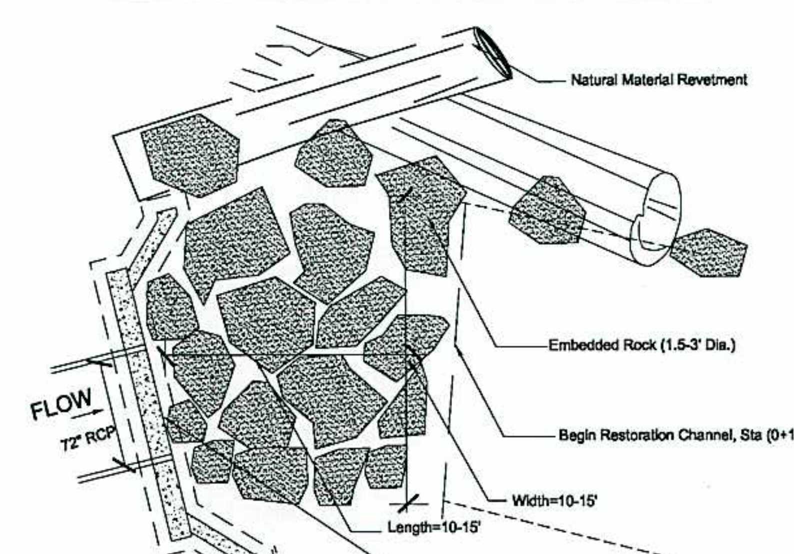
5 HEADWALL DETAIL: Sta (4+60) to Sta (4+65)

Presidio Trust



2 HEADWALL AND STORMDRAIN DETAIL: Sta (0+00) to Sta (0+15)

Presidio Trust



3 HEADWALL AND STILLING BASIN PLAN: Sta (0+0) to Sta (0+15)

Presidio Trust

REVISIONS	DATE:
Checked MJH	8/04
Approved MHJ	8/04

INFORMATION SOURCE:

PROJECT:
Presidio Fill Site 6A Channel Restoration
Inlet and Outlet Headwall Detail

CLEARWATER
HYDROLOGY
2974 Adeline St.
Berkeley, California
94703
Ph: (510) 841-1836

DRAWN BY: NM	PROJECT NO.: –
CHECKED BY: W.B.V.	DATE: 06-17-04
SHEET:	

FIGURE 6

CONSTRUCTION SPECIFICATIONS FOR FILL SITE 6A
PRESIDIO TRUST

1. Streamflow Diversion: Installation details and specifications will be prepared by the remediation contractor, subject to approval by the restoration contractor and supervising hydrologist. At a Minimum should include the following elements:

Groundwater seepage and direct rainfall entering the project reach will be captured and diverted around the construction area via the installation of instream sandbag dams fitted with plastic diversion pipes. Depending on the sequencing of the fill removal and channel restoration work, it may be possible to utilize a gravity flow diversion. However, if construction requires the pipes to be elevated above and outside of the work area, the diversion will require use of a small submersible pump. The diversion pipe will discharge to a second sandbag dam which will be installed at the lower end of the project reach. This second dam will collect groundwater seepage entering the work area and will act as a settling pond to reduce the turbidity of these seepage waters, prior to their release downstream. The second dam will be constructed with an overflow notch maximizing capture of fine sediments and will discharge onto the apron of the 72-inch storm drain at the lower end.

2. The extent and volume of fill required to achieve design grades within the restoration area will depend on the quantity of contaminated fill and debris removed from the project site prior to the channel restoration.

3. Skeletal elements of rapid-pool structures (i.e. the weirs) shall be constructed such that component boulders are installed with 2-3 pt. bearing with adjacent structural elements (e.g. boulders, logs) to increase local stability against mobilizing flows. Interstitial backfill (see Item 6 below) shall be placed within and immediately upstream of the weir boulders to further seal the weirs against loss of fines. Log elements integrated into the rapid-pool structures (i.e. weirs) shall be placed under the supervision of the project hydrologist.

4. Boulders utilized in the construction of the rapid-pool structures, natural material revetment, and storm drain inlet/outlet areas shall be competent rock. Possible rock type include: 1) Weathered basalt or 2) Mossy field stone. Boulders utilized will be inspected and approved by the supervising hydrologist and representatives of the Presidio Trust.

5. Boulder sizes shall range from 1.5 to 3.0 ft. in diameter, although smaller fragments can be utilized in the backfilling/sealing of the weirs. Weirs shall promote converging flow (i.e. aligned toward channel thalweg) and shall be aligned and constructed in accordance with the "Section/Plan Detail of Weir, Typ." in this plan set. Boulders smaller than 3.0 ft. in diameter shall be underlain by footer rocks so as to create a stable seat for the surface layer of boulders as per the detail.

6. Interstitial backfill at weirs shall be composed of a mixture of gravel (very small to large sizes), small cobble or rock fragments (dia.= 2.5- 8 inches), and very coarse sand (e.g. 1-2 mm).

The actual mix of backfill materials shall be inspected and approved by the supervising hydrologist prior to placement and should be placed under his/her guidance.

7. Acceptable log/rootwad species include redwood, cedar, alder and willow. Alternative species shall be first approved by the supervising hydrologist and the Presidio Trust ecologist prior to installation.

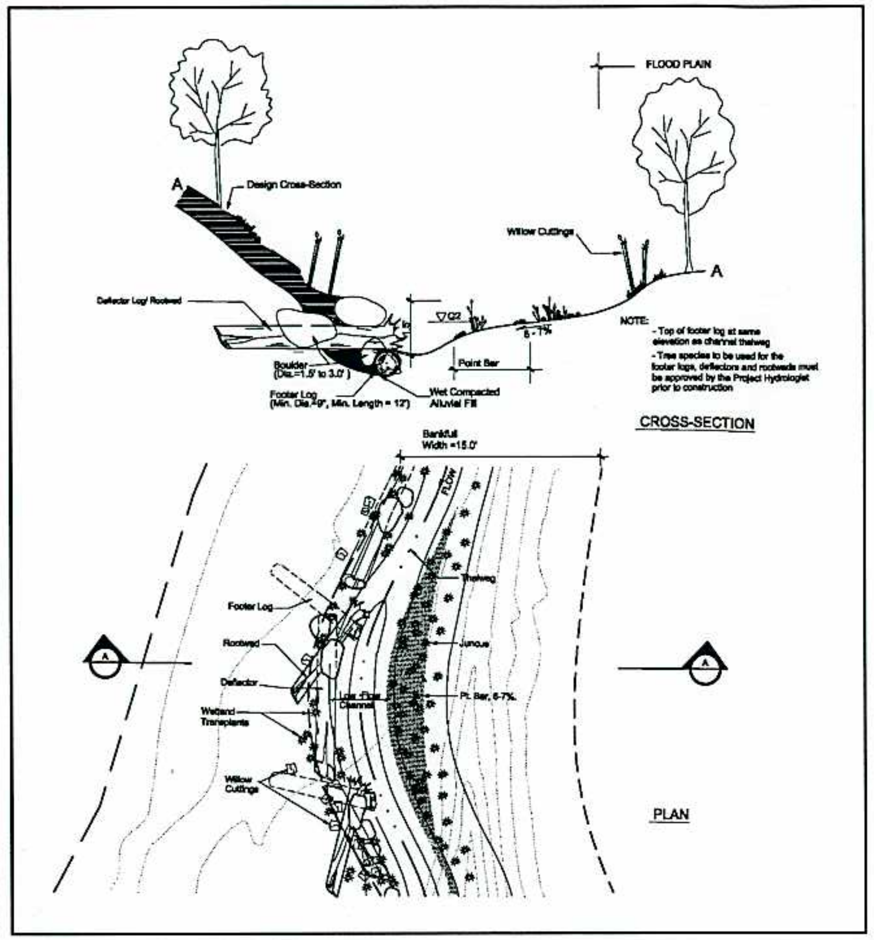
8. Logs and rootwads shall have minimum trunk lengths (excluding root bole) of 8 feet. If some shorter elements are required, the longer log/rootwad specimens can be cut to fit the particular site. Logs/rootwads shall be installed within the natural material revetment in accordance with specifications outlined in the "Natural Material Revetment, Typ." incorporated in this plan set.

9. Topsoil: The topsoil will be derived primarily from the the native subsoil underlying the the contaminated fill. Soil amendments, shall be placed, if required, at the direction of the Presidio Trust restoration ecologists.

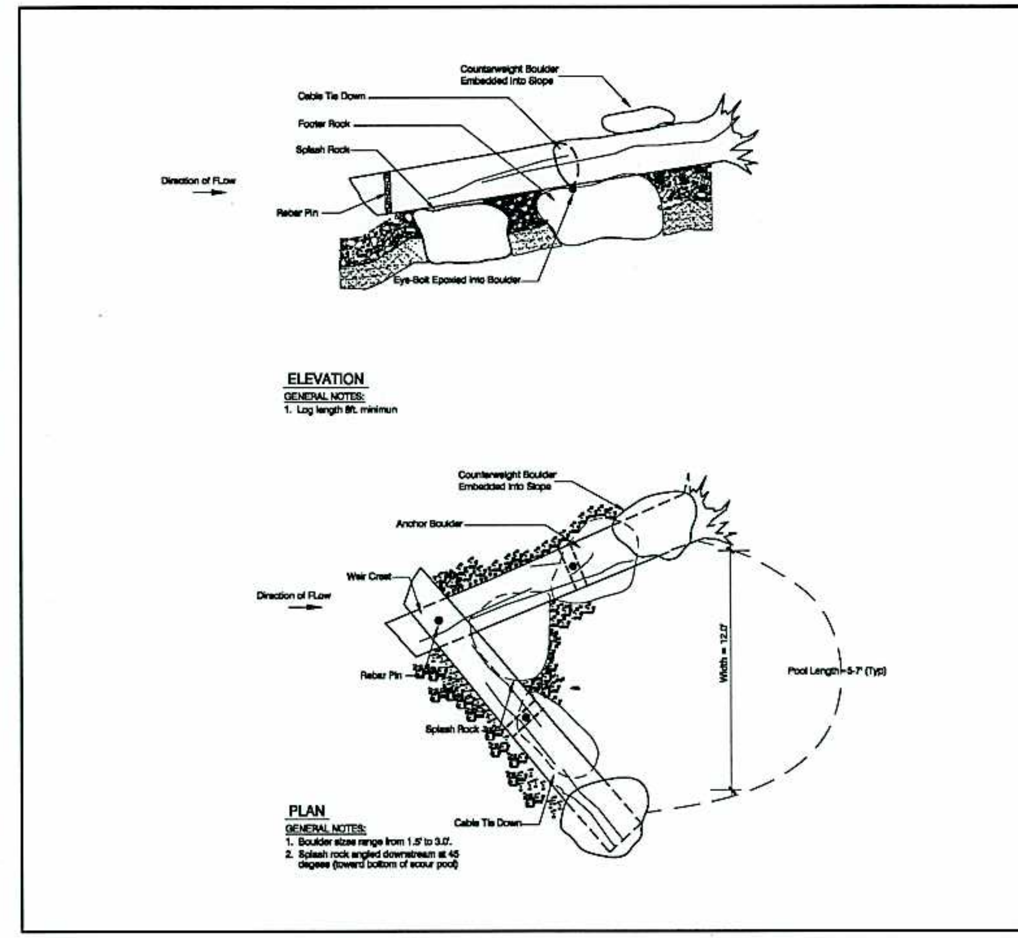
10. Compaction: Non-topsoil fill material used in the reconstruction of channel flood plains and/or high banks where required, shall be clean and free of debris and deleterious material and be approved by the Presidio Trust. Fill shall be moisture conditioned to at least 3.0 percent over the optimum moisture content and compacted to 80-85 percent relative compaction based on the ASTM D 1557 latest version laboratory test procedure. Field compaction can also be approved by the project geotechnical engineer.

11. Site Revegetation: Revegetation of the restoration flood plains and transition slopes will be conducted by the Presidio Trust in accordance with the Trust's "Fill Site 6A Revegetation Plan "(2004) and the "Vegetation Restoration Action Plan " (2004). Installation of stabilizing in-channel wetland and riparian species will be conducted by the restoration contractor (Watershed Science) in consultation with project hydrologist.

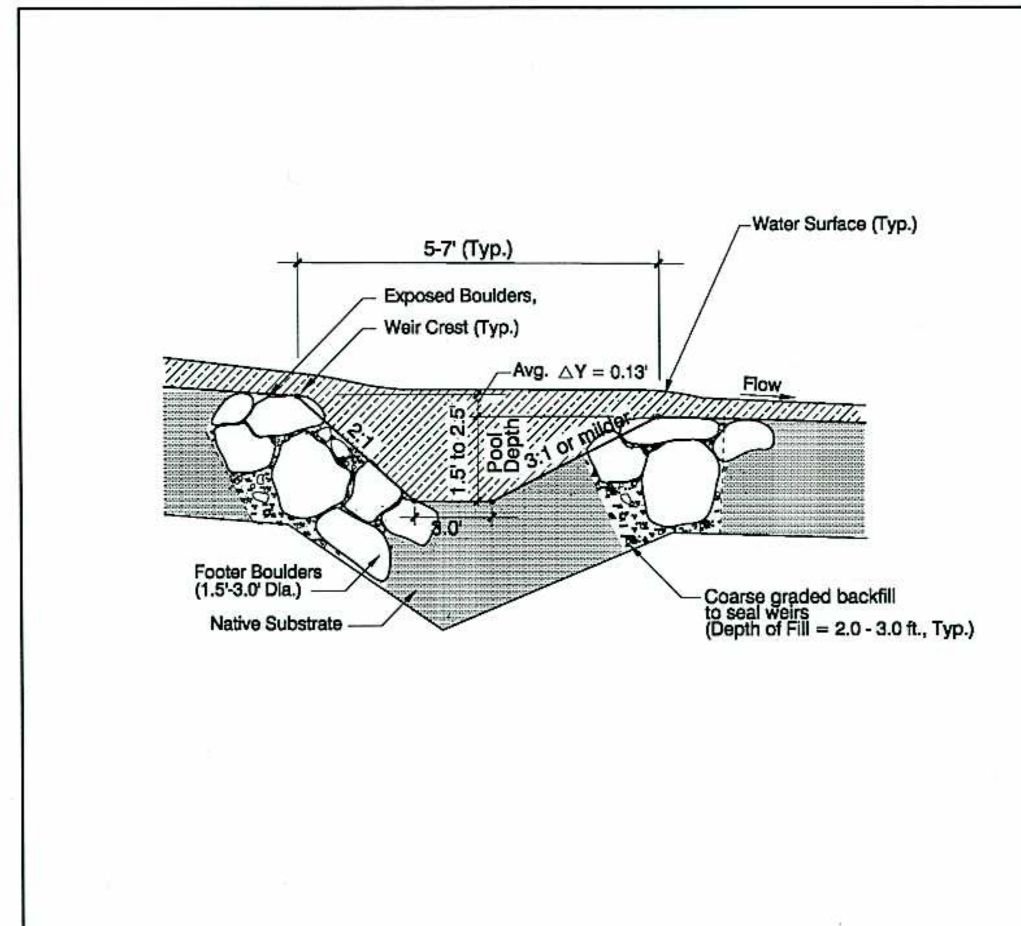
4 SPECIFICATIONS / NOTES
Presidio Trust



3 RESTORATION CHANNEL: Natural Material Revetment (Typ.)
VARIES Presidio Trust



1 RESTORATION CHANNEL: Section/Plan Detail at Weir (Typ.)
VARIES Presidio Trust



2 RAPID POOL PROFILE: Design Conditions (Typ.)
N.T.S. Presidio Trust

REVISIONS	DATE:
checked MJH	8/04
Approved MB	8/04

INFORMATION SOURCE:

PROJECT:
Presidio Fill Site 6A Channel Restoration
Restoration Plans & Specifications

CLEARWATER HYDROLOGY
2974 Adeline St.
Berkeley, California
94703
Ph: (510) 841-1836

DRAWN BY: NM	PROJECT NO.: -
CHECKED BY: W.B.V.	DATE: 6-17-04
SHEET:	

FIGURE 7

MACTEC
ENGINEERING & CONSULTING
10265 Rockingham Drive, Suite 150
Sacramento, California 95827
(916) 364-0793

LAYOUT OF PLANT COMMUNITIES
FILL SITE 6A RESTORATION
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
8

DRAWN	FILE NAME	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
FGH	C-PLANT-ZONE.DWG	55213	MJH	30-JUNE-04	8/04

APPENDIX A

TECHNICAL APPENDIX – CALCULATIONS AND MODELING INPUT AND OUTPUT

TECHNICAL APPENDIX

- FlowMaster Output
  - Typical Straight Reach
  - Typical Meander Reach
  - XSA
  - XSB
- Planimeter of Watershed
- Application of Rational Method
- Restoration Reach Inlet/Outlet Invert Elevations
- Channel Geomorphic Characteristics
- Critical Shear Stress
- Headwater Elevation at Outlet Headwall
- CALTRAN Standard Plan (D90A)

Straight Reach-Q2
Worksheet for Irregular Channel

Project Description	
Worksheet	design channel 3.0' bx
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharg	60.00	cfs

Options	
Current Roughness Methc	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.037	
Water Surface Elev	98.14	ft
Elevation Range	.60 to 100.00	
Flow Area	12.5	ft²
Wetted Perimeter	17.34	ft
Top Width	16.89	ft
Actual Depth	1.54	ft
Critical Elevation	98.13	ft
Critical Slope	0.022906	ft/ft
Velocity	4.79	ft/s
Velocity Head	0.36	ft
Specific Energy	98.50	ft
Froude Number	0.98	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.00	0+35.00	0.037

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	100.00
0+10.00	98.00
0+14.00	97.60
0+16.50	96.60
0+19.50	96.60
0+22.00	97.60
0+25.00	97.90
0+35.00	99.90

Straight Reach-Q100
Worksheet for Irregular Channel

Project Description	
Worksheet	design channel 3.0' b(
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharg:	241.00	cfs

Options	
Current Roughness Methc	wed Lotter's Method
Open Channel Weighting	wed Lotter's Method
Closed Channel Weightin;	Horton's Method

Results		
Mannings Coefficie:	0.041	
Water Surface Elev	99.25	ft
Elevation Range	.60 to 100.00	
Flow Area	37.5	ft²
Wetted Perimeter	28.69	ft
Top Width	28.01	ft
Actual Depth	2.65	ft
Critical Elevation	99.23	ft
Critical Slope	0.023013	ft/ft
Velocity	6.43	ft/s
Velocity Head	0.64	ft
Specific Energy	99.89	ft
Froude Number	0.98	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.00	0+35.00	0.041

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	100.00
0+10.00	98.00
0+14.00	97.60
0+16.50	96.60
0+19.50	96.60
0+22.00	97.60
0+25.00	97.90
0+35.00	99.90

Worksheet for Irregular Channel

Project Description	
Worksheet	Meander1-2.5 'bottom (n
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharg	60.00	cfs

Options	
Current Roughness Methc	wed Lotter's Method
Open Channel Weighting	wed Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.038	
Water Surface Elev	97.32	ft
Elevation Range	.10 to 100.00	
Flow Area	11.6	ft²
Wetted Perimeter	13.81	ft
Top Width	13.38	ft
Actual Depth	1.22	ft
Critical Elevation	97.30	ft
Critical Slope	0.023096	ft/ft
Velocity	5.17	ft/s
Velocity Head	0.41	ft
Specific Energy	97.73	ft
Froude Number	0.98	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.00	0+38.00	0.038

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	100.00
0+10.00	98.00
0+14.50	96.50
0+20.50	96.10
0+23.00	96.10
0+26.00	97.60
0+28.00	97.80
0+38.00	99.80

Meander Reach-Q100
Worksheet for Irregular Channel

Project Description	
Worksheet	Meander1-2.5 'bottom (n
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharge	241.00	cfs

Options	
Current Roughness Meth	wed Lotter's Method
Open Channel Weighting	wed Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficie	0.041	
Water Surface Elev	98.61	ft
Elevation Range	.10 to 100.00	
Flow Area	36.0	ft²
Wetted Perimeter	25.89	ft
Top Width	25.13	ft
Actual Depth	2.51	ft
Critical Elevation	98.60	ft
Critical Slope	0.022652	ft/ft
Velocity	6.70	ft/s
Velocity Head	0.70	ft
Specific Energy	99.31	ft
Froude Number	0.99	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.00	0+38.00	0.041

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	100.00
0+10.00	98.00
0+14.50	96.50
0+20.50	96.10
0+23.00	96.10
0+26.00	97.60
0+28.00	97.80
0+38.00	99.80

XSA-Q2
Worksheet for Irregular Channel

Project Description	
Worksheet	XSA- with wetland pond-modific
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharg	60.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.034	
Water Surface Elev	10.30	ft
Elevation Range	26 to 25.00	
Flow Area	16.1	ft²
Wetted Perimeter	36.89	ft
Top Width	36.47	ft
Actual Depth	1.04	ft
Critical Elevation	10.30	ft
Critical Slope	0.022506	ft/ft
Velocity	3.73	ft/s
Velocity Head	0.22	ft
Specific Energy	10.52	ft
Froude Number	0.98	
Flow Type	Subcritical	

Calculation Messages:
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	1+69.00	0.034

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	25.00
0+02.00	25.00
0+64.00	11.00
0+71.50	10.50
0+74.50	10.50
0+78.50	10.00
0+98.50	10.00
1+01.00	10.50
1+04.00	10.50
1+06.50	9.66

XSA-Q2
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
1+12.50	9.26
1+15.00	9.26
1+18.00	10.76
1+23.00	11.26
1+69.00	24.40

XSA-Q100
Worksheet for Irregular Channel

Project Description	
Worksheet	XSA- with wetland pond-modifie
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharg	241.00	cfs

Options	
Current Roughness Methc	wed Lotter's Method
Open Channel Weighting	wed Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.038	
Water Surface Elev	10.96	ft
Elevation Range	26 to 25.00	
Flow Area	46.9	ft²
Wetted Perimeter	56.10	ft
Top Width	55.49	ft
Actual Depth	1.70	ft
Critical Elevation	10.95	ft
Critical Slope	0.022637	ft/ft
Velocity	5.14	ft/s
Velocity Head	0.41	ft
Specific Energy	11.37	ft
Froude Number	0.99	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.00	1+69.00	0.038

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	25.00
0+02.00	25.00
0+64.00	11.00
0+71.50	10.50
0+74.50	10.50
0+78.50	10.00
0+96.50	10.00
1+01.00	10.50
1+04.00	10.50
1+06.50	9.66
1+12.50	9.26
1+15.00	9.26
1+18.00	10.76

Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
1+23.00	11.26
1+69.00	24.40

XSB-Q2
Worksheet for Irregular Channel

Project Description	
Worksheet	XSB- with wetland pond-modifie
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharg	60.00	cfs

Options	
Current Roughness Methc	wed Lotter's Method
Open Channel Weighting	wed Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.034	
Water Surface Elev	8.36	ft
Elevation Range	00 to 25.00	
Flow Area	15.9	ft²
Wetted Perimeter	35.98	ft
Top Width	35.51	ft
Actual Depth	1.36	ft
Critical Elevation	8.35	ft
Critical Slope	0.022422	ft/ft
Velocity	3.77	ft/s
Velocity Head	0.22	ft
Specific Energy	8.58	ft
Froude Number	0.99	
Flow Type	Subcritical	

Calculation Messages:
Flow is divided.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.00	1+76.50	0.034

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.00	25.00
0+02.00	25.00
0+69.75	8.40
0+73.75	8.00
0+76.25	7.00
0+78.00	7.00
0+79.25	7.00
0+81.75	8.00
0+84.75	8.30
0+85.75	8.50

XSB-Q2
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+88.75	8.50
0+92.75	8.00
1+07.75	8.00
1+11.75	8.50
1+72.75	23.00
1+76.50	23.00

XSB-Q100
Worksheet for Irregular Channel

Project Description	
Worksheet	XSB- with wetland pond-modific
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Slope	022000	ft/ft
Discharg:	241.00	cfs

Options	
Current Roughness Methc	wed Lotter's Method
Open Channel Weighting	wed Lotter's Method
Closed Channel Weightin;	Horton's Method

Results		
Mannings Coefficie:	0.039	
Water Surface Elev	9.02	ft
Elevation Range	00 to 25.00	
Flow Area	44.5	ft²
Wetted Perimeter	47.34	ft
Top Width	46.70	ft
Actual Depth	2.02	ft
Critical Elevation	9.00	ft
Critical Slope	0.023034	ft/ft
Velocity	5.42	ft/s
Velocity Head	0.46	ft
Specific Energy	9.47	ft
Froude Number	0.98	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00.00	1+76.50	0.039

Natural Channel Points

Station (ft)	Elevation (ft)
0+00.00	25.00
0+02.00	25.00
0+69.75	8.40
0+73.75	8.00
0+76.25	7.00
0+78.00	7.00
0+79.25	7.00
0+81.75	8.00
0+84.75	8.30
0+85.75	8.50
0+88.75	8.50
0+92.75	8.00
1+07.75	8.00

Natural Channel Points	
Station (ft)	Elevation (ft)
1+11.75	8.50
1+72.75	23.00
1+76.50	23.00

Calculate Area of Control Area

$A_c = 0.930 \text{ in}^2 / 4$ $\quad$ $\underline{A_c = 0.2325 \text{ in}^2}$

Map units $\underline{A = 160,000 \text{ ft}^2}$

Determine Area of entire watershed "Public Park" ($C = 0.33$)

$A_1 = 15.624 \text{ in}^2$

Determine Area of "Public buildings" Area ($C = 0.70$)

$A_2 = 1.5035 \text{ in}^2$

Determine Area of mixed "public buildings" & "Low urbanization" ($C = 0.55$)

$A_3 = 1.8855 \text{ in}^2$

Convert Planimeter units to map units

control Area

Conversion $\Longrightarrow$ $160,000 \text{ ft}^2 / 0.2325 \text{ in}^2 = 688,172 \text{ ft}^2/\text{in}^2$

$A_1 = (15.124 \text{ in}^2) \cdot (688172 \frac{\text{ft}^2}{\text{in}^2}) = 1.0752 \times 10^7 \text{ ft}^2 = 246.8 \text{ Acre}$

$A_2 = 1.0347 \times 10^6 \text{ ft}^2 = 23.75 \text{ Acre}$

$A_3 = 1.2975 \times 10^6 \text{ ft}^2 = 29.78 \text{ Acre}$

Rational Method → $Q = CIA$

USGS Version of Rational Method → Source:

Rantz, S.E. 1971 "Suggested Criteria for Hydrologic Design of Storm Drainage Facilities in the San Francisco Bay Region, California" U.S. Geological Survey open file Report, Menlo Park, CA. Nov. 1971

Precipitation Data → Source:

Rantz, S.E. 1971 "Mean Annual Precipitation and Precipitation Depth-Duration Frequency Data for San Francisco Bay Region" Basic Data Contribution 32, U.S. Geological Survey, Menlo Park, CA October 1971

Determine watershed Area

Entire watershed = 246.8 Acre

open Space (public park) = 193.26 Acre = 78.31%
public buildings = 23.75 Acre = 9.62%
medium density urbanization = 29.79 Acre = 12.07%

Determine composite "C"

$C_{openspace} = 0.25$
$C_{public\ building} = 0.70$
$C_{medium\ density} = 0.55$

$$C_{composite} = (0.7831 \cdot 0.25) + (0.0962 \cdot 0.70) + (0.1207 \cdot 0.55)$$

$$C = \underline{0.33}$$

Determine Mean annual Precip.

≈ 20 in/yr

Calculate the % impervious (composite) ~ (table + Rantz)

$(0.0962 \cdot 50) + (0.1207 \cdot 32.5) + (0.7831 \cdot 12) = \underline{18.13}\ \%$

Determine travel time (i.e. Storm duration)

over land flow Slope - 0.18 (upper watershed)

overland length = 400 ft ← Rough ≃

channel length = 2000 ft

~~storm drain system = 1600 ft~~

estimate time

overland = 15 min (Figure 6 Rantz 1971)

"natural" channel = 13.3 min

V = 2.5 ft/s

storm drain using mannings equation to detemine Velocity

$$V = \frac{0.59}{n} D^{3/4} S^{1/2}$$

n = Roughness Coeff. (.012)
D = diameter - (18" Avg)
S = Slope (3% Avg)

$$V = \frac{0.59}{.012} (1.5)^{3/4} (.03)^{1/2}$$

V = 11.54 ft/s

Time = 2.31 min

Total time = 15 + 13.3 + 2.31 = 30.6 min

Storm precip (... table 4)

Q2 →

30 min = .38
60 min = .48

$.38 + .1\left(\frac{.6}{30}\right) = .382$

Q10 →

30 min = .57
60 min = .73

$.58 + .15\left(\frac{.6}{30}\right) = .583$

Q100 →

30 min = .79
60 min = 1.00

$.79 + .21\left(\frac{.6}{30}\right) = .7742$

Determine Storm intensity (I) in/hr

Q2 − $(.382) \cdot \frac{60 \text{ min/hr}}{30.6 \text{ min}}$ = 0.74 in/hr

Q10 − $(.583) \cdot \frac{60}{30.6}$ = 1.14 in/hr

Q100 − $(.774) \frac{60}{30.6}$ = 1.55 in/hr

Peak flow
Q=CIA

		Kamman
Q2 = (0.33)(0.74)(246.8) = <u>60.27</u> cfs		46.5
Q10 = (0.33)(1.14)(246.8) = <u>92.84</u> cfs		102
Q100 = (.63)(1.55)(246.8) = <u>241</u> cfs		215

Purpose: [illegible] Calculate the [illegible] outlet elevation [illegible] Constructed Headwalls

d/s culvert (May 21st Survey)

Assume: pipe is 3" thick

Information: Ground Surface elevation @ excavation
= 22.4'
Surveyed pipe height
= 12' bgs

invert elevation = 22.6' - 12' - 6.25' = <u>4.35'</u>

Location of pit: ≈ 70' from stairs
≈ 45 from HW (to be installed)

u/s culvert (May 26th Survey)

Information: Ground Surface = 36.0'
pipe invert = 22' bgs

u/s culvert invert elevation @ pipe elbow (72" pipe)

Invert elevation = 36' - 22' = 14.0

<u>Determine pipe Slope</u>

pipe length ≈ 410'

Slope between the two points = (14-4.35)/410'
= 0.023

<u>Elevation @ u/s outlet</u>

Distance of elbow from ≈ location of Headwall
= 20' (two pipe segments)

14' - (20' × .023) = <u>13.52'</u> ≈ 14'

Elevation @ D/S [illegible]

Distance of pit from d/s culvert Headwall $= 40'$

$$4.35' - (35 \times .023) = \underline{\underline{3.54'}} \simeq 4'$$

Channel Slope = 2.2%

Entrenchment Ratio = 1.89

Width / Depth Ratio = $\frac{W_{bankfull}}{d_{bankfull}}$

Avg. Depth = $\bar{d}$ = $\frac{\text{Flow-Area}}{\text{Top width}} = \frac{12.5\ ft^2}{16.89\ ft} = 0.74'$

$$\frac{\bar{w}}{\bar{d}} = 16.89'/0.74' = 22.8$$

Sinuosity

Valley Slope / channel Slope

$$0.030/0.022 = 1.36$$

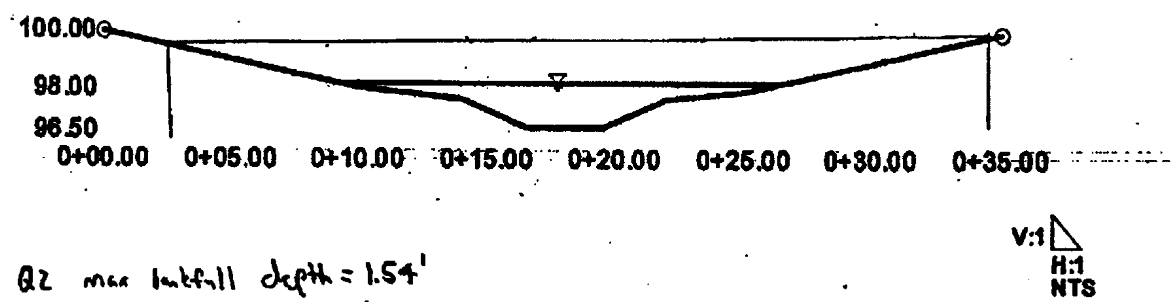
*Valley Slope - rough approximation based on upper bank slope

Rosgen Stream classification System - Stream type B5 (Rosgen)

Typical Straight Reach
Cross Section for Irregular Channel

Project Description	
Worksheet	design channel 3.0' bottom (the new
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficie	0.037
Slope	0.022000 ft/ft
Water Surface Elev	98.14 ft
Elevation Range	.60 to 100.00
Discharge	60.00 cfs



Q2 max bankfull depth = 1.54'
Q2 bankfull width = 11.89'
2x bank full depth = 3.08'
Flood Prone width = 34.5' - 2.5' = 32'

Entrenchment Ratio = 32'/11.89 = 1.89

Presidio [illegible] Channel Sheerstress 1

$\tau_c = \gamma R S$

Where: τ_c = critical Sheer Stress
R = hydraulic Radius
S = Slope (water Surface = bed Slope)
γ = unit weight of H_2O

Q2

$R = \frac{\text{Flow Area}}{\text{wetted Perimeter}} = \frac{A}{P} = \frac{12.5\ ft^2}{17.34\ ft} = 0.72\ ft$

$\tau_c = \left(62.4\ \frac{lb}{ft^3}\right)(0.72')(0.022) = 0.99\ lb/ft^2$

From graph (sheer stress vs Grain diameter)

Grain diameter = 65 mm sediment size which could be transported = 2.6 in

Q100

$R = \frac{37.5\ ft^2}{28.67\ ft} = 1.30'$

$\tau_c = \left(62.4\ \frac{lb}{ft^3}\right)(1.30')(0.022) = 1.79\ lb/ft^2$

Grain diameter which could be transported = 170 mm = 6.7 in

To compute the approximate size of a rock that might be moved on the streambed, use the shear stress

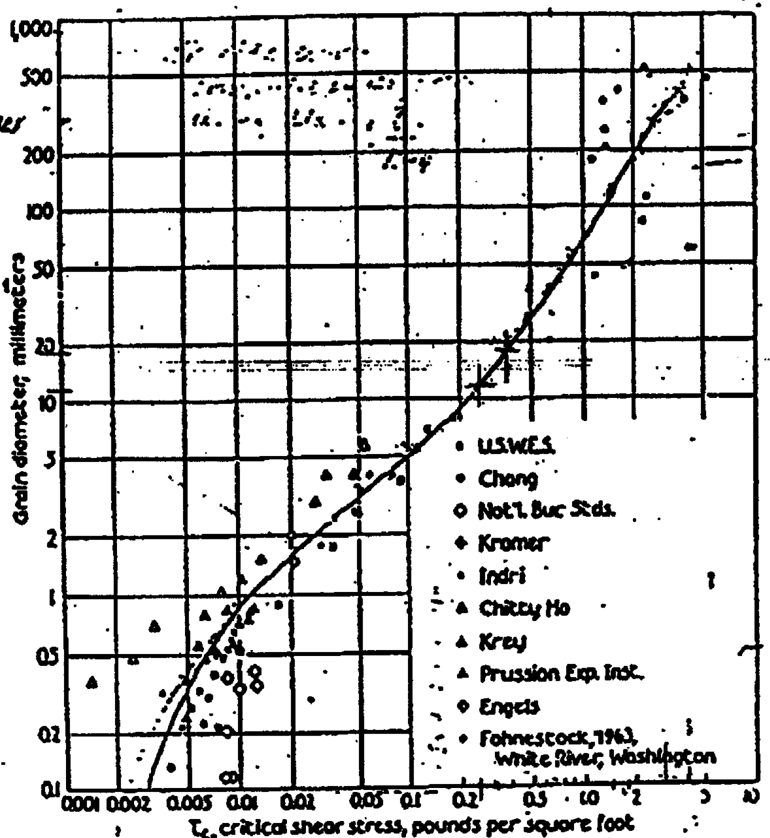
$$\tau_0 = \gamma d s \quad \text{or} \quad lb/ft^2 = \text{unit weight of water} \times \text{depth} \times \text{slope (English units)}$$

$$\tau_{0\,(lb/ft^2)} = 62.4 \times \text{depth}_{(ft)} \times \text{slope}$$

Enter τ_0 on abscissa below, read rock size in mm on ordinate.

$1 \frac{N}{m^2} = 10 \frac{dynes}{cm^2}$

$1 \frac{lb}{ft^2} = 479 \frac{dynes}{cm^2}$



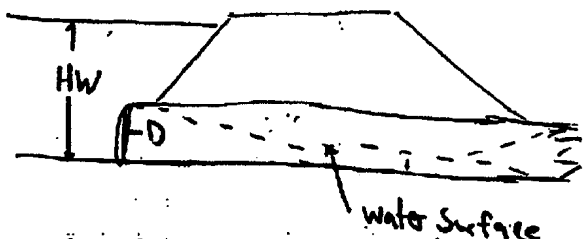
N/m² .02 .05 .1 .2 .5 1 2 5 10 20 50 100

Dynes/cm² 1 10 100 1000

culvert information

inlet elevation = 4.0'
foot path elevation (low point) = 18'
72' circular concrete pipe
Q100 = 240 cfs

Assume:
inlet control



outlet may be submerged @ high tides
* Not include in evaluation

HW = headwater (water surface elevation @ inlet structure)
D = pipe diameter = 72" = 6'

From chart 1 (Norman, J.M et al)

$$\frac{HW}{D} = 1.13$$

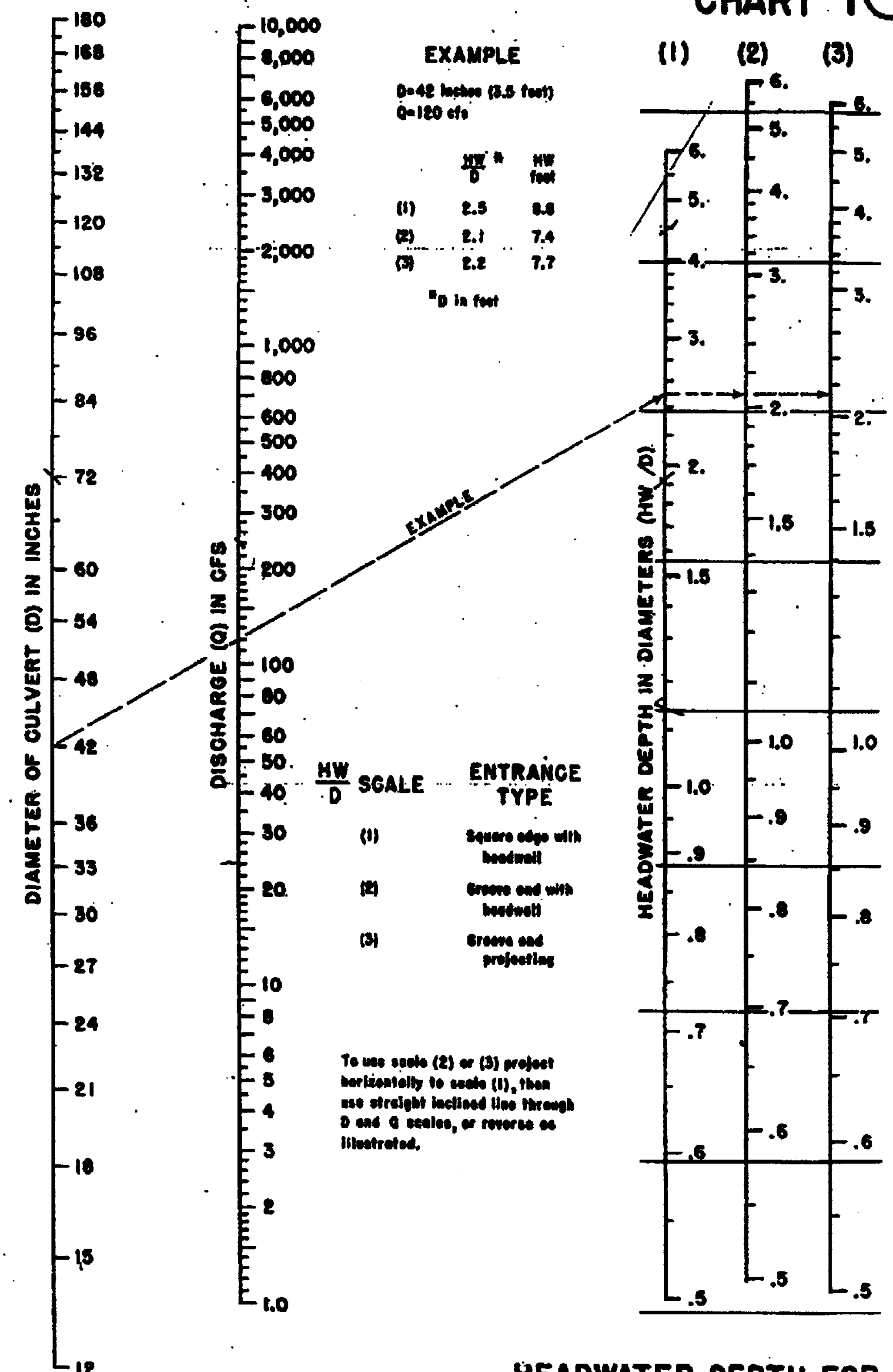
$$HW = 1.13 * (6') = 6.78'$$

Change in elevation = 18' - 4 = 14'

HW will not overtop path

* calculation does not look @ backwater effects.

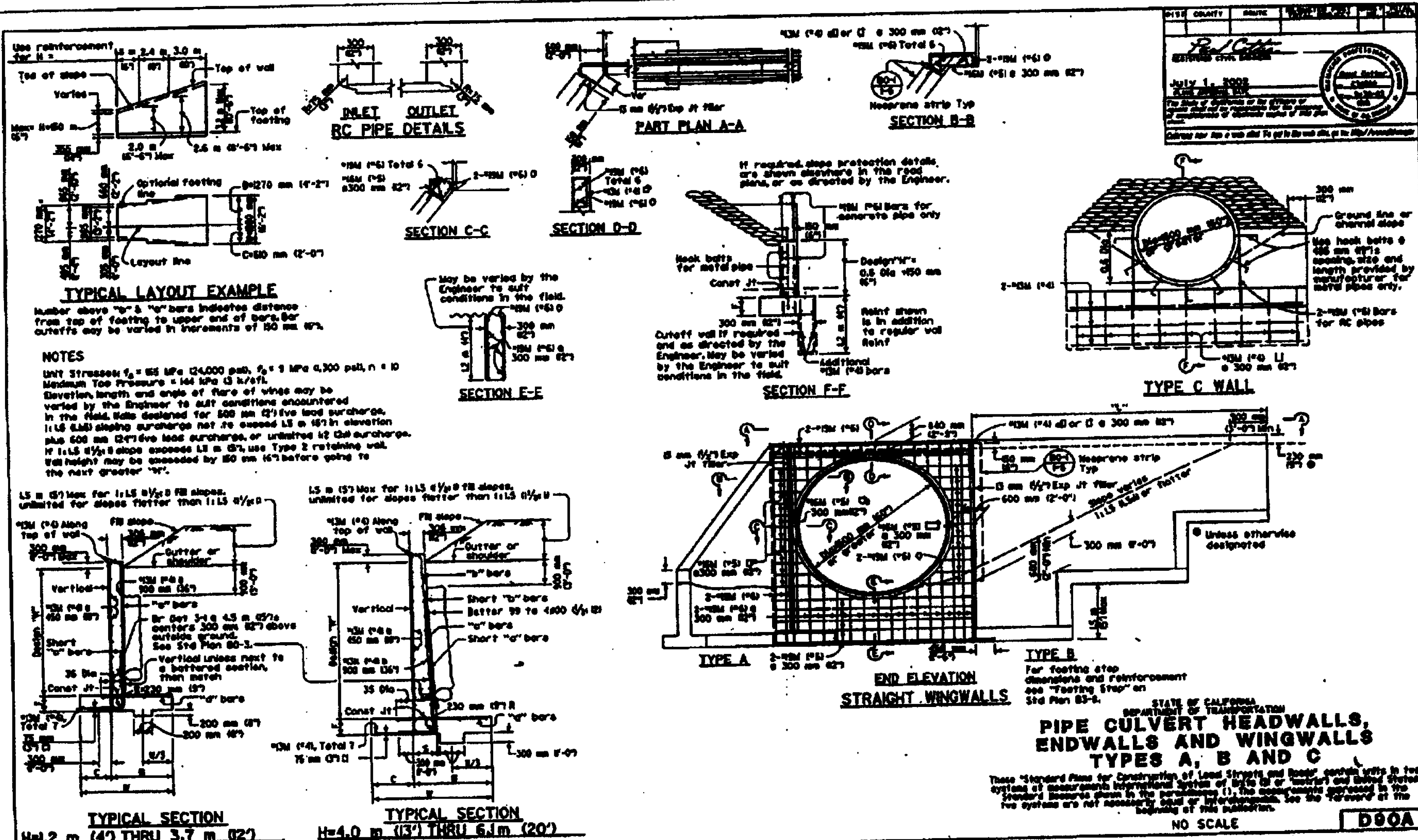
CHART 10



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



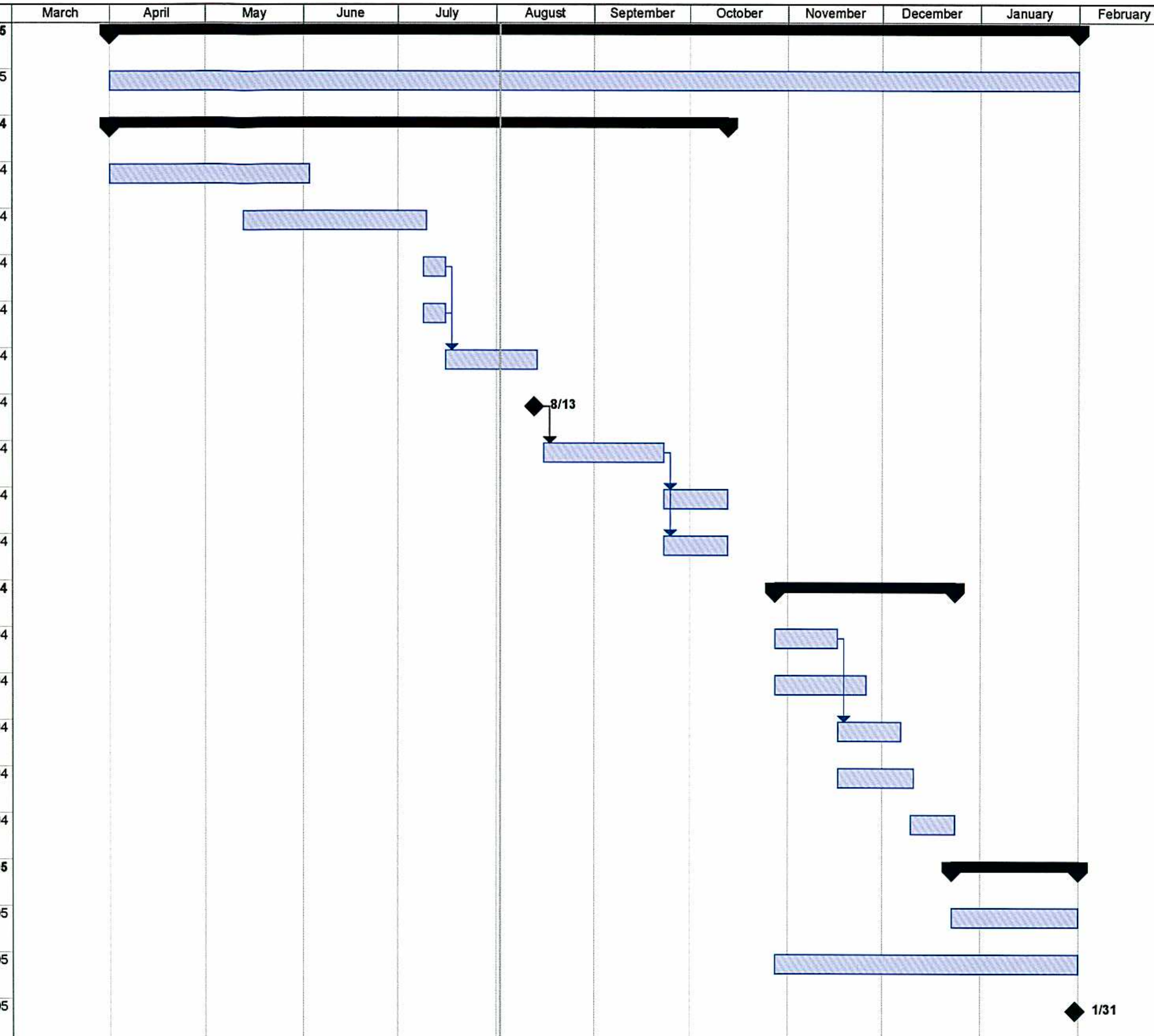
TYPICAL LAYOUT EXAMPLE
Number above "b" & "e" bars indicates distance from top of footing to upper end of bars. Bar cutoffs may be varied in increments of 150 mm (6").
RC PIPE DETAILS
INLET
OUTLET
PART PLAN A-A
SECTION B-B
Neoprene strip Typ
SECTION C-C
SECTION D-D
SECTION E-E
May be varied by the Engineer to suit conditions in the field.
SECTION F-F
If required, slope protection details are shown elsewhere in the road plans, or as directed by the Engineer.
Hook bolts for metal pipe
Const Jt
Cutoff wall if required and as directed by the Engineer. May be varied by the Engineer to suit conditions in the field.
TYPE C WALL
Ground line or channel slope
NOTES
TYPICAL SECTION
H=1.2 m (4') THRU 3.7 m (12')
TYPICAL SECTION
H=4.0 m (13') THRU 6.1 m (20')
TYPE A
END ELEVATION
STRAIGHT WINGWALLS
TYPE B
For footing step dimensions and reinforcement see "Footing Step" on Std Plan B3-9.
Unless otherwise designated
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
PIPE CULVERT HEADWALLS, ENDWALLS AND WINGWALLS
TYPES A, B AND C
NO SCALE
D90A

APPENDIX B

ESTIMATED RESTORATION CONSTRUCTION SCHEDULE

PRESIDIO SAN FRANCISCO
FILL SITE 6A RESTORATION
ESTIMATED RESTORATION CONSTRUCTION SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**Presidio Trust - Fill Site 6A Restoration**	**218 days**	**Thu 4/1/04**	**Mon 1/31/05**
2	Fill Site 6A Restoration	218 days	Thu 4/1/04	Mon 1/31/05
3	**Restoration Design**	**139 days?**	**Thu 4/1/04**	**Tue 10/12/04**
4	Draft Design	45 days?	Thu 4/1/04	Wed 6/2/04
5	Draft Restoration Plan	42 days	Thu 5/13/04	Fri 7/9/04
6	Presidio Trust Internal Review	5 days	Fri 7/9/04	Thu 7/15/04
7	NPS Review	5 days	Fri 7/9/04	Thu 7/15/04
8	Draft Final Restoration Plan	21 days?	Fri 7/16/04	Fri 8/13/04
9	Submittal to RWQCB	1 day?	Fri 8/13/04	Fri 8/13/04
10	Regulatory Review	28 days	Mon 8/16/04	Wed 9/22/04
11	Final Design	14 days	Thu 9/23/04	Tue 10/12/04
12	Final Restoration Plan	14 days	Thu 9/23/04	Tue 10/12/04
13	**Restoration Construction**	**41 days**	**Thu 10/28/04**	**Thu 12/23/04**
14	Channel Construction	14 days	Thu 10/28/04	Tue 11/16/04
15	Storm Drain Out- and Inlet Structures	21 days	Thu 10/28/04	Thu 11/25/04
16	Final Grading	14 days	Wed 11/17/04	Mon 12/6/04
17	Erosion Control Measures	18 days	Wed 11/17/04	Fri 12/10/04
18	Planting	10 days	Fri 12/10/04	Thu 12/23/04
19	**Completion Report**	**28 days**	**Thu 12/23/04**	**Mon 1/31/05**
20	Complete Final Restoration Report	28 days	Thu 12/23/04	Mon 1/31/05
21	Project Management	68 days?	Thu 10/28/04	Mon 1/31/05
22	End of Project	1 day	Mon 1/31/05	Mon 1/31/05



Project: fS 6a restoration const schedu
Date: Mon 8/2/04

Task	Progress	Summary	External Tasks
Split	Milestone	Project Summary	External Milestone
Deadline			

Checked MJ+
Approved MJ

APPENDIX C

EROSION MONITORING PLAN

EROSION MONITORING PLAN

Fill Site 6A

This Plan presents a general discussion of erosion monitoring methods that will be implemented after construction has been completed and the Storm Water Pollution Prevention Plan SWPPP (Appendix B of *MACTEC, 2004*) has been terminated by filing a Notice of Termination with the Regional Water Quality Control Board (RWQCB).

Monitoring Period

The Erosion Monitoring Plan will be in effect after construction has been completed. Erosion monitoring and control during construction and during the first wet season after construction is covered by the SWPPP. The SWPPP specifies Best Management Practices (BMPs) that will be implemented during construction to prevent all construction pollutants from contacting storm water and with the intent of keeping all products of erosion from moving off site into receiving waters.

Monitoring of erosion and the status of the BMPs is part of the erosion monitoring plan which will be in effect until the site has been sufficiently re-vegetated that erosion is no longer an issue.

Maintenance Activities during Monitoring Period

Anticipated maintenance activities include routine maintenance of BMPs, side slopes, storm drain out- and inlet structures, weed abatement, and temporary installation of erosion control structures during winter rains (if necessary). All maintenance activities will be undertaken to minimize and control erosion.

Best Management Practices

Exposed soil after excavation and grading poses a clear danger of storm water pollution. The following BMPs are relevant to the work being performed at the project site. The remediation and restoration contractor will implement temporary soil stabilization and sediment control measures, as appropriate, to minimize impact to storm water runoffs from the project site, such as

- Storm drain outlet protection and velocity dissipating devices
- Stream bank stabilization measures
- Silt fences
- Fiber rolls
- Straw bale barriers (weed-free)
- Storm drain inlet protection

Erosion control measures will be in place after construction has been completed and must be maintained at all times regardless of weather conditions. Imminent rainfall may trigger the deployment of additional erosion control measures.

Controlling Runoff

Erosion results from a combination of factors: decreased soil stability, increased runoff volumes, and/or increased flow velocity. Therefore, the most effective erosion control practices combine drainage diversion and surface roughening.

Record Keeping

Inspections performed during the monitoring period will be documented by the Trust's representative. These reports will be kept in the project file at the Trust's offices at 1750 Lincoln Boulevard. Inspections performed during the plant restoration and post-restoration phases will be recorded and transferred to the Trust project file upon completion of the erosion monitoring.

Storm Water Diversion Measures

A SWPPP will be implemented during construction and during the first wet season after construction had been completed. Additional storm water diversion measures during the erosion monitoring period will be designed as part of the erosion monitoring plan and promptly implemented as needed.

Post-Construction Plant Restoration

Specific methods and controls that will be implemented to prevent and monitor erosion that may occur after excavation and remediation activities at the Site will be conducted by the Trust's finish grading and channel construction contractor, Watershed Science.

After removal of the soil and debris, backfill, and grading, erosion control measures will be expected to occur in Summer 2004. Trust remediation personnel in conjunction with the restoration contractor will inspect the erosion control measures as needed during the dry season to ensure the erosion control measure remains in serviceable condition.

Planting in the landscape zone will begin in late 2004 at the onset of winter rains. During the wet season (November through April) the erosion control measures will be inspected weekly and after major storms by restoration personnel. Planting will continue in winter months until completed.

As the plants become established over several seasons, erosion control measures will be permitted to gradually decay, or in some cases will be removed. Decisions on whether to remove, modify, or maintain post-construction erosions control features will be made by a team of experienced Trust and NPS remediation and restoration personnel. During this phase, if Site soils begin to move and re-establish natural conditions, some sediment may leave the Site propelled by natural processes through the newly-constructed channel constructed as an erosion control measure. Trust personnel will inspect the Site at least weekly during the rainy season, and as soon as possible after significant storms.

The Trust and NPS remediation and restoration personnel will review the Site conditions and make judgments on the need to periodically remove, maintain, or augment the remaining erosion control measures. Site inspections performed during this phase will occur as needed, but will not be less than monthly. The inspections will occur approximately daily during the beginning of the rainy season when changes in Site conditions will be most likely. The frequency of inspections will decrease when it becomes apparent that Site conditions have stabilized. Inspections will stop when the responsible staff has concluded that the Site has achieved the desired natural conditions, and that it is safe for the inspections to stop.

EROSION MONITORING PLAN - PRESIDIO FILL SITE 6A
INSPECTION FORM

Observation Location	Date & Time	Presence of Floating and Suspended Solids / Debris	Presence of Oil and Grease (Sheen)	Discoloration (Altered in Color)	Turbidity (Clear to Muddy)	Notes	Corrective Action Taken
Storm Drain Outlet							
Channel							
Storm Drain Inlet							
Slopes							
BMP's							
Restored Vegetation							
Person Conducting Inspection: Print Name: ______________________________ Signature___________________________________-:							

DISTRIBUTION

Draft
Fill Site 6A
Restoration Plan
Presidio San Francisco
San Francisco, California

August 13, 2004

Copy No. ____

Copies 1-8:	Mr. George Ford The Presidio Trust Environmental Office 1750 Lincoln Boulevard Presidio of San Francisco, California 94129
Copy 9-10:	Mr. Bill Vandivere Clearwater Hydrology 2974 Adeline Street Berkeley, California 94703
Copies 11-12	MACTEC Files

Quality Control Reviewer

Steve J. Hickey, P.E.
MACTEC Engineering and Consulting
Senior Principal Engineer

MJ;kb/KB60692D.DOC-PRESIDIO